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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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World Competition

WHETHER or not the average man and woman realises the fact, there has started a polite and peaceful war for world domination. Not with directly political aims, but backed by grim determination nevertheless. In greater or lesser degree practically every country is involved, although only three or four are directly concerned at the moment. World-girdling air routes are occupying the attention of the nations directly interested, and the effects of their operation will ultimately be felt in most other countries.

Great Britain and America, through Imperial Airways and Pan-American Airways respectively, have already come very close to completing the world circuit by the experimental transatlantic flights on the one hand and by the regular service from San Francisco to the coast of Asia on the other. In a few months Great Britain will extend her flying boat services to Australia, thus more than completing the circuit. In a year or so the air mail service across the Atlantic may well be in operation, so that the girdling of the globe, at present experimental over certain sections, will be a working one throughout.

In these days of mechanical miracles the event will probably pass almost unnoticed. The careful preparation and thorough equipment of the routes with meteorological and radio services will, it is to be hoped, ensure such regularity and safety that the public may well be forgiven for concluding, in its usual way, that "there was nothing much in it after all."

The importance of such a girdle round the world in the matter of prestige cannot be over-estimated. But prestige has to be paid for, and the keen competition which is certain to arise may well make the cost more staggering than is generally realised. Imperial Airways strove for many years towards the ideal of becoming self-supporting, and the scale of subsidies then granted by the Government was such that the company was actually compelled to plan its services with that aim in view. Competition from other countries has compelled a reconsideration of policy, and the Empire air mail scheme is the result. Among other changes it necessitated the building of new flying equipment, and the Empire boats, of which some thirty have been ordered, were the result.

With their cruising speed of 160 m.p.h. and their remarkable comfort for passengers, these boats will do all that is necessary for the moment, but already there are signs that they will prove inadequate in a very few years. The inauguration of the air mail scheme will probably ensure that the machines fly mostly with full payloads, and that will help materially towards economic operation; but there is no way of preventing, or even limiting, competition, even if it were desirable to do so. It is obviously not desirable to prevent it, since to do so would deprive the public of the benefit of the latest advances in aeronautics; yet on the other hand there must be an economic limit to the route speeds which can be maintained. Fortunately, these things have a habit of sorting themselves out. Frequency of service and speed of transport have always attracted traffic, and will doubtless be found to do so on the long-distance air routes.

The Australian Link

As far as the world's airways are concerned, Australia is in a peculiar position. It is just a little disturbing to contemplate Pan-American Airways' plans for operating a regular service to Auckland towards the end of the present year. That service, which is unlikely to show financial returns for a good many years, will establish American prestige, and will have to be countered by us in some way. The most obvious, and certainly the one most likely to succeed, is to go one better in frequency of service and in route speed to Australia.

After many delays, agreement has been reached between the British and the Australian Governments, and Mr. Hudson Fysh, managing director of Qantas Empire Airways, is at present in this country to discuss matters of detail with our own people.

Flight has ever lent a ready ear to Australia's difficul-

ties, and it was interesting to obtain from Mr. Hudson Fysh confirmation of our view that Australia's attitude has not been dictated by any "dog-in-the-manger" feelings. The plan is going to cost Australia a good deal of money, and she was, not unnaturally, a little nervous about the possibility of losing a certain amount of control. Fortunately, it looks as if all these difficulties have now been overcome, and the new scheme will provide for a considerable pooling of control, equipment and personnel.

Useless Barbarity

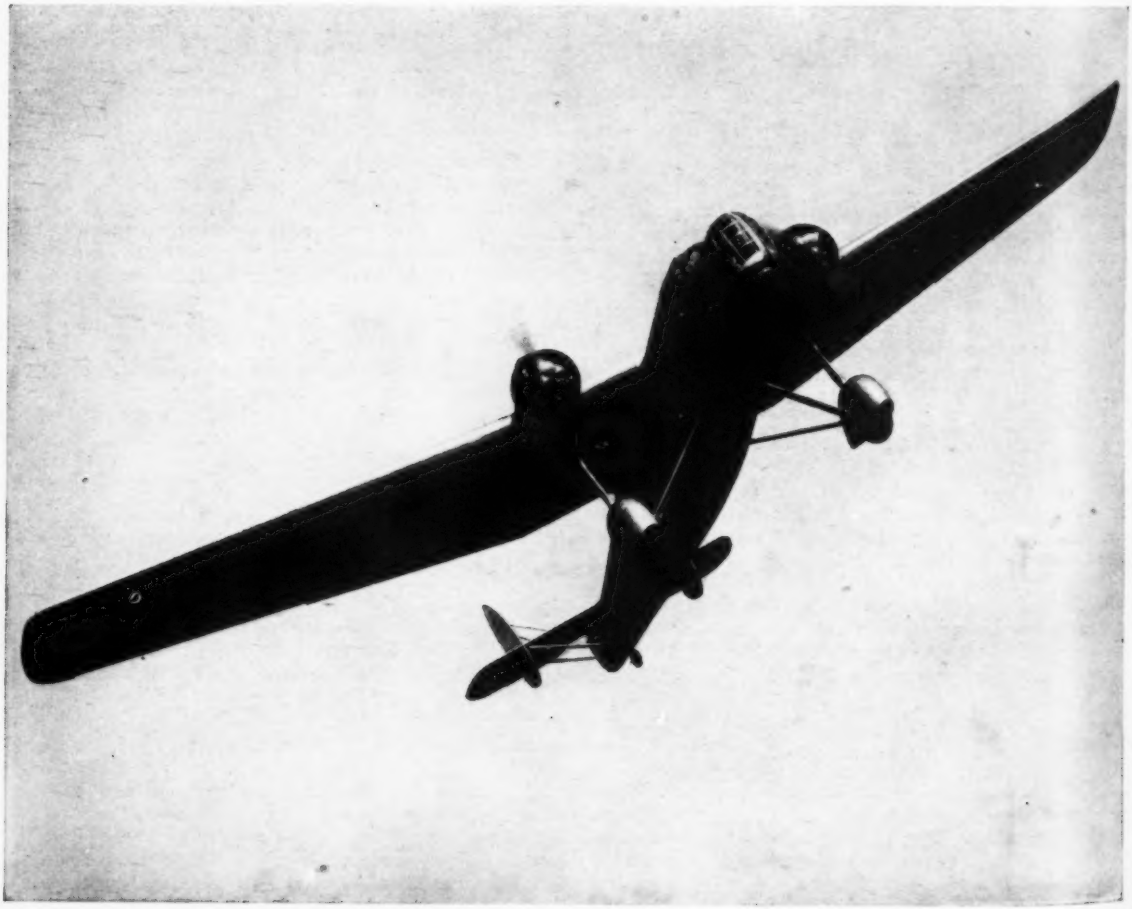
THE wholesale slaughter of Chinese civilians in Nankin and Canton has aroused the horror of the whole civilised world, of which Japan claims to be a member. Protests have been made by the leading Governments of Europe and of the United States, and with the spirit of those protests *Flight* is in full agreement. The Japanese might plead that, though their bomb raids have been on a more destructive scale than anything ever done before, they are, from the moral point of view, no worse than much that has recently happened in Spain or during the Great War. If the slaughter of civilians in either of those cases had actually produced the effect of breaking the spirit of any nation or party so that it clamoured for its Government to surrender, then a military result would have been achieved and the Japanese could have pleaded military necessity as an excuse.

No such demand for surrender has ever been caused by "frightfulness" practised on a virile population. Probably the sacking of captured towns by soldiery in the dark ages caused even worse horrors than bombs can ever cause, but that brutality was never a short cut to a national victory. Brutality produces anger, not submission.

The Obvious Lesson

It is time that this lesson was grasped by all nations. It is no use for well-meaning sentimentalists to clamour for the abolition of all military aircraft. Bombers are in essence long-range guns, and as such they are necessary to belligerents. What is deplorable is that in many quarters the belief has been growing that what is euphemistically called "striking at nerve centres" is to be a normal and, indeed, a useful feature of all future wars. Even young officers of the Royal Air Force may sometimes be heard discussing the subject without horror, apparently in the belief that bombing civilians really will defeat an enemy. By this time it has been shown over and over again that such a result is not to be expected. Let all and sundry take the lesson to heart.

Bombers and reconnaissance aircraft are invaluable to a General, and the latter certainly to an Admiral as well. Let them be confined to their proper uses. Air attacks on civilians are as useless as they are execrable.



TROOPER-BOMBER : The Bristol Bombay (Type 130) bomber-transport which recently conveyed British Staff Officers to the German manoeuvres. The Bombay is being built in quantity by Short and Harland. With two Bristol Pegasus Xs (960 h.p. max.) the performance is a revelation.

The Outlook

A Running Commentary on Air Topics

The Day

AERONAUTICAL history is likely to be made during the next few days when, all being well, the first separation of *Mercury* and *Maia* will take place. The flying tests with *Maia*, the lower component of the Short-Mayo composite aircraft, were completed some time ago and certain minor alterations made. Mercury, the upper component, has now also made a number of flights, piloted first by Mr. Lankester Parker and afterwards by Mr. Piper, and has been found to need no modifications whatever. Not only so, but, as recorded in *Flight* recently, *Mercury* has exceeded the designed speed by nearly 20 m.p.h.

In view of the experimental nature of the first separation, quite exceptional precautions have had to be taken in order to ensure that other aircraft shall keep away from the vicinity. This, if ever, is an occasion when aeroplanes carrying photographers must obviously be warned off; their presence in the vicinity would be grossly unfair to the two pilots who are, after all, taking a certain risk in testing in actual flight the operation of the release mechanism, which has already been "bench tested." It is to be hoped that the wishes of the firms concerned and of the Air Ministry will be scrupulously observed. The official Press craft will be one of the Empire flying boats piloted by an Imperial Airways pilot who will previously have arranged with the two Short pilots the exact details of the procedure. The presence of any unauthorised aircraft might quite possibly endanger the other three.

Given freedom from outside interference, there is no reason to expect the separation to be other than entirely successful. There is an elaborate signalling system between the two pilots, including telephone, and the release mechanism is so arranged that, not until they have in turn pulled their release levers can the third—automatic—release operate; and then only if the lift of the upper component exceeds its weight by a certain predetermined amount. For example, if this excess of lift is set at 5,000 lb., separation cannot occur until that figure is reached or exceeded. The result should be that the upper component has a tendency to climb when relieved of that load, and the lower should tend to drop.

Col. Muirhead's Tour

COL. A. J. MUIRHEAD, Under-Secretary for Air, was not very illuminating in the interview which he gave to the Press on his return from his tour in Africa. He had met Mr. Pirow, the Union Defence Minister, at Mombasa, and had discussed air transport in Africa with him, as well as "some matters which had a defensive bearing." He talked about air transport in Africa being "a field for speculative developments" for some time to come, and said that during the development of air services there it was not to be expected that people would always play for economic safety.

This would seem to mean that on a stretch between Kisumu, where the route of the Empire boats turns off towards the coast, and Lusaka in Northern Rhodesia, two lines are running in more or less opposition to each other. One is Wilson Airways, which is one of the associated companies of Imperial Airways, and the other is South African Airways, the official company supported by the Union Government. Col. Muirhead stated that a measure of agreement had been reached between them, but it would certainly seem that there is competition between two companies where there is probably all too little traffic for one. Wilson Airways get the mail contracts from the Governments of Kenya and Tanganyika, whereas South African Airways have the resources of the Union behind them. Such competition must be a waste of somebody's money, and so far as defence goes it cannot strengthen the interests of the Empire in Africa.

Battalions by Parachute

THE Russian Army goes on increasing the number of parachutists which it drops in a single operation, always complete with light machine guns. At the recent manœuvres the number went up to 2,200, which is certainly impressive, at least as an accomplishment. It proves the possession by the Soviet Government of a large number of troop-carrying aircraft, and it also arouses admiration for the hardihood of the Russian infantry. Most airmen dislike the idea of a descent by parachute, and the objection of nearly all ground-worms is very much stronger still. All honour to the Russian infantry that it can find so many men who will face the ordeal.

As for the military value of the operation, most authorities agree that in European warfare it cannot be high, though it might be very effective against semi-civilised opponents. The parachutists might bring off a raid on communications, but it would seem inevitable that they would never get back to their own lines, and therefore would sacrifice themselves. In fact, in modern warfare the value of infantry unsupported by other arms is very problematical.

Stubs or Floats?

THE mishap to the flying boat *Cambria* in Canada, which resulted in her being laid up for several weeks while repairs to her damaged wing-tip float could be effected, has once again drawn attention to the old question of which is the more satisfactory method of lateral stabilisation of a flying boat on the water—outboard floats or sponsons. British flying-boat designers have had relatively little experience with sponsons, or, as we prefer to call them in this country, stubs. German designers, on the other hand, notably Dr. Dornier, have always shown a marked preference for stubs.

The accident to *Cambria*, it may be argued, affords no proof one way or the other, as the float struck a floating object, and a stub, under similar treatment, would have fared no better. That is probably quite true, but past experience does appear to show that the most vulnerable part of a flying boat when it is being handled on the water is the wing-tip float. Cobham lost one in the Mediterranean many years ago, and there have been other instances.

If the stub or sponson is markedly inferior as to its aerodynamic and hydrodynamic effects on performance, any extra seaworthiness which it may confer on the aircraft may be bought too dearly, but an Aeronautical Research Committee Report, a summary of which is published on *The Aircraft Engineer* pages in this issue, seems to indicate that this need not necessarily be so. Tests made in the Farnborough tank and elsewhere seem to indicate that the effect of stubs on take-off can be made negligible, and that take-off time, longitudinal stability and maximum speed are the same for stubs and floats. The stubs are from 0.5 to 3 per cent. heavier than the floats, and the lateral stability of a boat fitted with stubs is not quite so good.

Thus the price to be paid for the advantages of stubs does not appear high, and experiments should be continued.

DIARY OF FORTHCOMING EVENTS—PAGE 338

Some Night-and Day-flying Impressions of the v.p. Vega Gull : Very Complete Equipment on Air Hire's Latest Acquisition: Long-distance Cruising at 170 m.p.h

HIGH-SPEE

PRIVATE ownership carries its own particular blessings, not the least of which is freedom in time and space. Nevertheless, for amateur pilots who fly less than a couple of hundred hours in a year—and they form the vast majority—this pleasant freedom is, unfortunately, something of a luxury. Part-ownership is the best to which most of us can aspire, whether in actual partnership with other enthusiasts, or as a member of a club.

By their very nature, however, only one or two of the most prosperous clubs can spare machines for more than a few hours at a time, and the prospects even of an unsubsidised "drive-yourself" hire firm might appear to be particularly good. During the past year or two Air Hire, of Heston, have done their best to fill this gap with quite a comprehensive fleet. In fact, they deserve rather more credit than they have received, but that is another story.

Their latest acquisition, a v.p. Vega Gull, opens something of a new chapter in the history of their operations. It is also, in more ways than one, a shot in the dark. Metaphorically, because it is yet to be discovered whether, with the help of an occasional charter, there is a sufficient number of clients who require the speed, size and comparative luxury of such a machine. Actually, because the machine is fully equipped for night-flying training and "B" licence tests. Whether or not it will be possible to send people off on their test at a very competitive rate remains to be seen, but they will certainly be sent off in great comfort and elegance. Mr. Giles Guthrie (who should know a Vega Gull in the daylight, anyway) is to be the first patient.

Nocturnal Try-out

With the idea of discovering something about this Vega as a night-flying device, I took the opportunity of flying in it last week while Mr R. H. Barlow tried out the Rotax landing lights and so on at Heston, and a few days later I had a chance of flying the machine around myself for an hour or so.

Forgetting the very slight "single-engined" anxiety experienced, it was quite the most pleasant and comfortable night ride that I have ever had. The cabin of the Vega is nicely warmed by two hundred air-cooled horses in front, yet it is properly ventilated, and one can see out in all essential directions. If the outside world loses its interest or importance, one can switch on the cabin light and appreciate the cosiness of one's immediate surroundings—an advantage in the case of any "B" aspirants who suffer from momentary spasms of nostalgia while making their first night cross-country. It is possible to feel very lonely in an open machine at 2,000 ft. in pitch darkness.

We cruised about in the almost completely calm air for half an hour, flying to Watford in a northerly direction and to Surbiton in a southerly, making, in the interim, a landing with the sole aid of the machine's own lights. These are built into the leading edges, one being arranged to give local and the other to give more distant illumination. In fact, their setting was not quite right, but there was nothing the matter with Mr. Barlow's landing, though the unpainted airscrew disc and the amount of moonlight must have made things rather difficult for him.

Pleasant though it is to be able to see something of the country down below, moonlight interferes with the effectiveness of man-made illuminations, just as it does when driving a car, and it was not possible to appreciate the full value of the landing lights for anything more than the actual touch-down. On a really dark night (moonlight is taboo for "B" flights, anyway) it should be possible to make quite satisfactory use of them during the approach. One small piece of bad organisation concerned the switch arrangement. The navigation and instrument lighting systems are in the same circuit, so that when the instrument light is switched off in order to obtain the best outside view for the approach and landing, the machine's navigation lights are also off. The pseudo-boost gauge is the only instrument not fully illuminated, and all the essential dials are phosphorescent, so they can be read in complete darkness.

One flying feature—apart, of course, from the good take-off provided by the v.p. airscrew—is worth mentioning from the point of view of night operations. It is practically impossible to judge an approach correctly in relation to boundary and obstruction lights, and a rumbling arrival is, consequently, a *sine qua non*. The use of the throttle affects the flaps-down gliding trim of the Vega only slightly, and it is, in fact, possible to "blip" one's way in without any noticeable change in air speed, which can easily be held at a safe 65-70 m.p.h. until the moment of hold-off.

For some reason or other the Vega Gull is looked upon by the novice pilot as something of a handful. There are one or two things to look after. It is a biggish machine and it is probably not one with which one may take unreasonable liberties at low air speeds, but there is nothing about it with which the normally intelligent pilot cannot deal. In fact, the machine has light and responsive controls and, once in the air, requires no concentration whatever—except that of remembering to look for the next landmark rather earlier than one might expect; it gets along. With the Series II Gipsy Six and D.H. v.p. airscrew, the compete idiot can possibly over-rev the engine almost to bursting point on the climb, and may even fly in coarse pitch with the pseudo-boost gauge continuously on the "plus" side to the engine's eventual detriment, but the same sort of person might also wreck the engine of a car. In common with the majority of modern machines it should be flown by brain rather than by brawn.

The shortest take-off, for instance, is obtained with the machine almost in climbing attitude throughout the run; as soon as it shows signs of being airborne, the stick is eased gently back an inch or two. Alternatively, however, it can be held level until an indicated speed of 60 m.p.h. is shown and then pulled off. Even with the v.p. airscrew relative loading appears to make very little difference to the length of the run taken, and the acceleration beyond 50 m.p.h. is outstanding. So much so that it is morally difficult to climb steeply enough to keep the air speed down to 75 m.p.h. and the revolutions down to a 2,400 maximum.

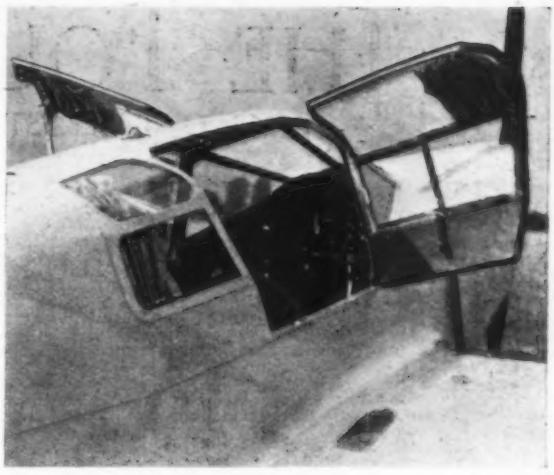
While making a spiral climb up to 5,000 ft. in fine pitch

with little load on board, the position of the nose seemed to be quite impossible even at an indicated air speed of 80 m.p.h. When the airscrew control is pulled there is a run-down-gramophone effect and the revolutions drop to 1,800 while the speed is built up. 5,000 ft. is not full-operating height, and it was necessary to throttle back a little in level flight in order to keep the manifold pressure down to the recommended −3 lb. on the gauge. Even so, the average indicated air speed over a twenty-mile run without appreciable loss of height was 150-155 m.p.h. (or 164-169 m.p.h. actual). The machine's official cruising maximum at 7,000 ft. on full throttle and 2,100 r.p.m. is something more than 170 m.p.h. Unfortunately, it is not often practicable to fly at this altitude; at 2,000 ft. the indicated cruising speed seemed to be about 155 m.p.h. (actual) with the boost needle where it should be.

Approach Technique

The desire to make every approach a forced landing approach (just in case) is still strong within me, and I tried various methods with the Vega. When attacking the subject in the usual right-angle fashion—i.e., closing the throttle during the circuit and gliding round until the machine is in the correct position for the glide-in, with or without flaps—only one out of five approaches to two different aerodromes demanded motor. In case of a real forced landing it would probably be better to make S-turns in the usual way on the leeward side of the field and to use the flaps as one would use a sideslip in a training type. Actually, the Vega can, if necessary, be made to do a sort of flat slip, with the flaps either up or down, at an air speed of about 80 m.p.h., but there should be no need for such a manœuvre if the chosen field is large enough. In the ordinary course of events I found that the machine reacted very nicely indeed to a rumbling approach, the speed remaining quite constant at all reasonable throttle openings, and by such methods one could get it into the smallest aerodrome at the first attempt. I landed between two previously noted marks at Hatfield and used only 150 out of the available 200 yards—yet the machine was quite new to me.

A curiosity of the flap effect is that, while steepening the glide very effectively at speeds in excess of 65 m.p.h., they are not too pungent at low speeds. Consequently, there is plenty of time to hold off with accuracy and no fear that the machine will "die" without warning during the checking process. The fact that the flaps can be lowered without effort or possible strain, at any speed up to 100 m.p.h., might be a very useful one. A good deal of aesthetic pleasure can be derived from the business of carrying out the sequence of operations during the approach with unhurried smoothness, and, on the pre-take-off check, the number "Four" is the critical one: Airscrew in fine pitch? Trim neutral? Flaps off (or 15 deg. on)? Brakes fully off?



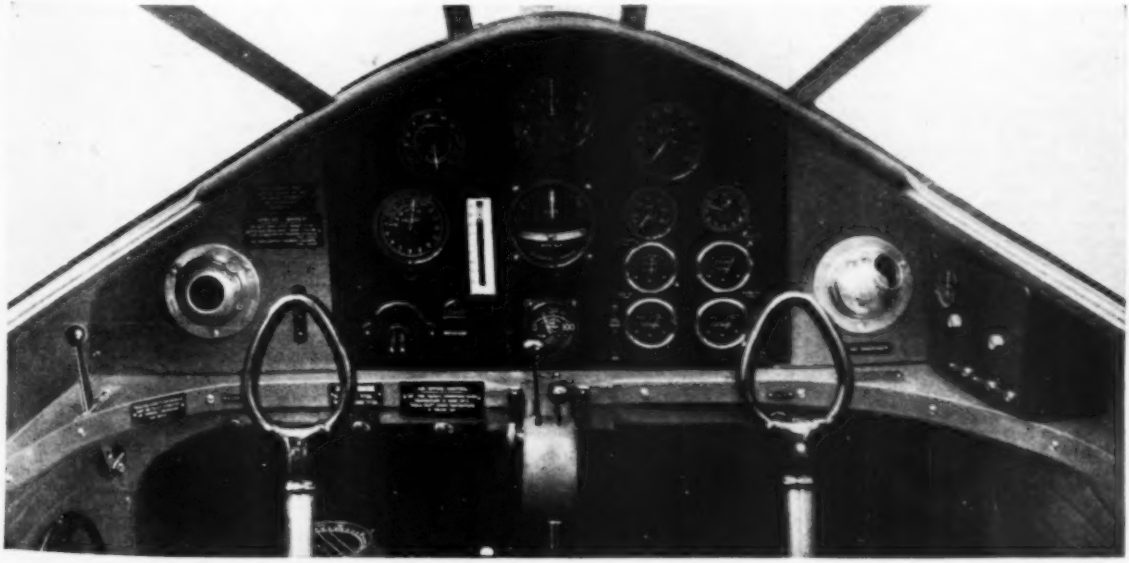
Two wide doors simplify, as far as possible, the business of entry into the front or rear seats of the Vega Gull. (*Flight* photograph.)

As far as the general arrangements are concerned, I objected only to the position of the rudder bar. This is too near the floor and there are no heel channels, so it is necessary to fly with one's insteps. Apart from the fact that this is not the most sensitive or easily managed part of the foot, its use shortens the effective leg length—and the Vega requires almost full left rudder at one point during the take-off.

Air Hire's Vega Gull is, of course, fully equipped for night flying, so there is a battery *and* a generator. Consequently, the electric starter can be used without qualms. Neither is there any need to lift the cowling; there are cabin controls both for the fuel pumps and the flooding pin. Why such things should be considered as luxuries in a modern aeroplane, I cannot say, but I certainly appreciated them.

Finally, this machine has special tanks and a range of about 1,000 miles in still air. Nobody will be able to say that it is not possible now to hire a really useful long-distance four-seater.

INDICATOR.



The instruments and engine controls of the v.p. Vega Gull. On the extreme right is the landing and navigation light switchboard, while on the left is the useful left-hand additional throttle lever. At the base of the dashboard can be seen (on the left side) the fuel pump, airscrew pitch and intake controls, with (behind the dual stick) the flooding control. The gauges for the four fuel tanks are on the right of the dash, and the boost gauge is in the centre at the top. (*Flight* photograph.)

THE FOUR WINDS

ITEMS OF INTEREST FROM ALL QUARTERS

(Above) **GERMANY'S WAR GAME: Troops taking cover beneath the wing of a Messerschmitt Me. 109 fighter during the recent mock air raid on Berlin, for which 7,000 public shelters were built. Details of the Me. 109 are well worth study.**

(Right) **RUDY'S RACER: The Folkerts Menasco-engined monoplane with which Rudy Kling, an agricultural worker, took the Greve and Thompson Trophies at the U.S. National Air Races. Kling landed it twice with the wheels up.**

IT is believed that the projected Sikorsky double-decker flying boat will be powered with six double-row Wright Cyclones of about 1,500 h.p. each.

A new glider record has been established by Herr Ziller, the German instructor. He attained a height of more than 16,000 ft with a passenger. Meanwhile M. Clamanus, a Frenchman, has "glid" for 11 hr. 10 min.

A Kobe municipal aerodrome is being discussed. The proposed site is at present a dense forest and covers a huge area. The promoters of the scheme hope to see the new aerodrome established by 1940, and students and other workers are being canvassed to put in a certain number of hours' voluntary labour each week.

Five "jumping" Autogiros have been ordered by the Air Ministry. These and the Hafner gyroplane will be the subjects of civil, naval and army tests next year.

Some recently announced attendance figures give an idea of the success of Empire Air Day this year. Bracketed figures represent last year's totals: Biggin Hill 9,239 (6,940); Filton 5,629 (2,710); Halton 7,027 (1,260); Northolt 20,519 (7,420); Usworth 14,077 (3,480). The net takings were £14,847 18s. 4d.

Twenty-five Years Ago

(From "Flight" of September 28, 1912.)

"Wishing to demonstrate his complete confidence in a parachute which he had designed and made, a paperhanger named Bittner threw himself off the top of the Pillar of Victory, in Berlin, on Sunday. The apparatus, however, failed to work, and the inventor fell to instant death at the foot of the monument.

The manufacturers of the Scheldemusch biplane are building for K.L.M. a long-distance monoplane, believed to be capable of over 250 m.p.h., with three 850 h.p. Wright Cyclone Gs. It will be used for experimental trans-Atlantic work.

Flight regrets to record the death of Mr. W. E. du Cros, who was one of the founders of the Dunlop Rubber Co. He was also interested in the early airships, and in 1910 flew in the Clement-Bayard dirigible from Compiègne to London, covering 246 miles in six hours.

The third Brancker Memorial Lecture will be held under the auspices of the Institute of Transport on Tuesday, November 16, at 6 p.m., at the Institute of Electrical Engineers. It will be delivered by Lord Sempill, and the subject will be "Civil Aviation as a World Force."

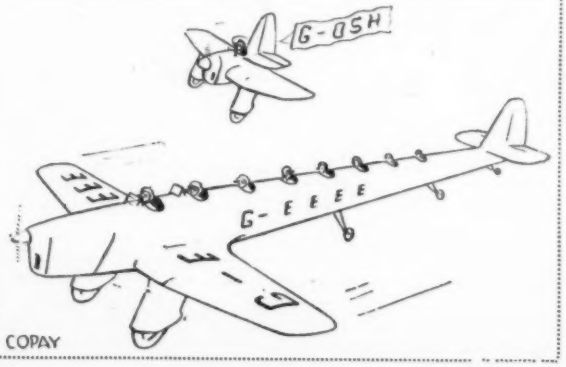
Accompanied by an apprentice-engineer, Mr. G. B. S. Errington, Airspeed's chief test pilot, has made one of the longest delivery flights ever attempted. He flew a Cheetah IX-engined Envoy from Portsmouth to Liu Chow, in China (about 9,000 miles) in just under 53 flying hours.

Some appalling weather was encountered, particularly in the monsoon area, and on the run to Bangkok the cockpit was drenched by tropical rain. The main fuses blew and even the rev. indicators became waterlogged. Most of the paint was stripped off the leading edge, cowlings and nose, but Mr. Errington managed to get the machine shipshape before delivery.

THE UNKIND UNTRUTH

(with apologies in all directions)

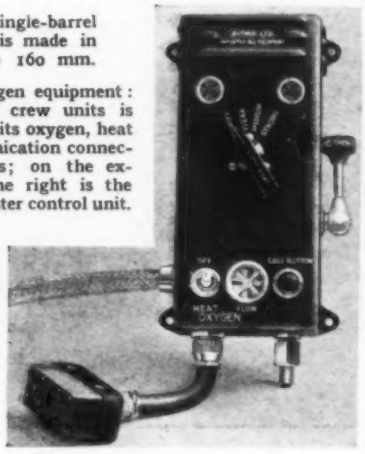
No. 6. Miles Long and Miles Short



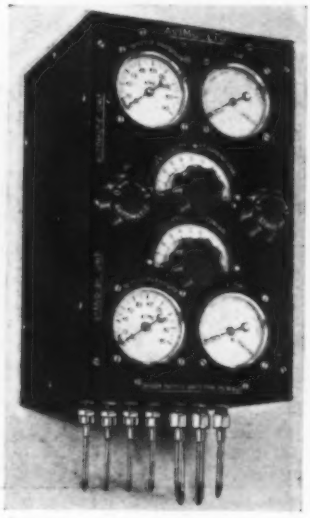
TO be MADE in ENGLAND

Avimo, Ltd., to Produce Bronzavia Range of Components and Accessories

(Left) The single-barrel carburettor is made in sizes up to 160 mm.



(Right) Oxygen equipment: one of the crew units is shown, with its oxygen, heat and communication connections; on the extreme right is the master control unit.



ANYONE with any pretentions to knowledge of Continental aircraft must be familiar with the equipment which goes under the name of Bronzavia. Best known among these products is probably the Bronzavia carburettor, and, next, a flame-damping exhaust system (frequently used on Hispano and other engines) which is of such unorthodox appearance—it oddly suggests a towel-rail—that it immediately attracts attention.

In addition to these two items there is a surprisingly extensive range of other Bronzavia specialities, and now comes the news that they are to be made under licence in this country by a company formed for the purpose under the title of Avimo, Ltd. Work has already started, in a factory of 72,000 sq. ft. area at Taunton, Somerset.

All British

An all-British concern, Avimo, Ltd., has as its directors Mr. H. C. M. Stevens and Air-Comdr. B. C. H. Drew, C.M.G., C.B.E., R.A.F. (Retd.). The latter, incidentally, is the officer who has so successfully run the whole of the non-flying side of the Hendon Display for a number of years.

Briefly to review the equipment which the firm will manufacture, there is first the carburettor, one of the chief features of which is an automatic altitude compensator and an automatic boost control, both actuated by a special form of barometric capsule with an ingenious safety device to obviate the danger of weakening of the mixture in the event of a capsule failing.

Next may be mentioned the flame damper, for both radial and in-line engines. The system releases the gases in long, narrow, vertical ribbons projected vertically across the slipstream, so securing virtually instant cooling. The system is light and simple and offers little aerodynamic resistance. The value of a flame damper, incidentally, lies not only in making the machine less easily visible from the ground, but in preventing dazzling of the pilot at critical moments, e.g., when taking off.

Even more undesirable than exhaust flames are intake flames—in other words, backfires. Therefore, there is an Avimo flame-trap, so made of a dense nest of "Y"-section stainless steel strips that, while offering minimum resistance to the mixture (imagine the gas flowing *up* each letter "Y") it will trap and cool out a backfire trying to blow *down* the "Y."

On a rather similar principle there is an air-intake sand-trap.

Another interesting Avimo product is an engine speed synchroniser for two or more power units; briefly, its action depends on an engine-driven differential which influences a small servo motor operating the throttle controls. There is, of course, provision for the pilot to override the automatic device.

Then there is a wonderfully complete oxygen distribution apparatus, made in types for military and civil aircraft. In addition to supplying automatically a proportional quantity of oxygen according to altitude, the distributor has distant supply points which enable each member of the crew of, say, a big bomber, to plug-in for oxygen, electrical heating and telephone.

Other products which the Taunton factory will turn out will include control-movement dampers, airscrew brakes (to prevent further damage in the event of engine breakages), sparking plugs, screening harness, and a bomb-sight or sextant spirit-level with automatic compensation to preserve the bubble-shape at high altitude.

The firm has produced a most informative catalogue, describing all these items in detail. It can be obtained from the Taunton works.

Who Killed Richthofen?

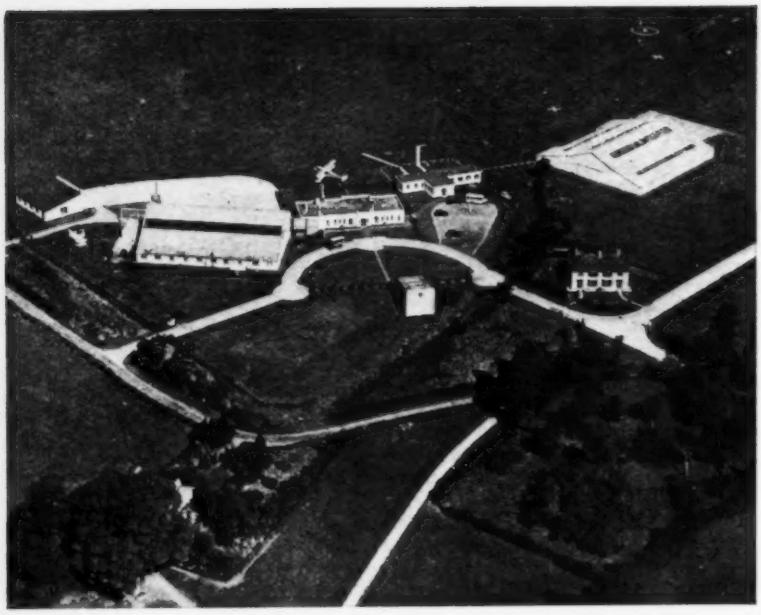
"Official History of Australia in the War of 1914-18, Vol. V." By C. E. W. Bean; Angus and Robertson, Ltd., 89, Castlereagh Street, Sydney.

THIS volume of 762 pages tells the story of the part played by the Australian troops in France during the German offensive of 1918, while an appendix tells of the work of Australian wireless and other technical units in Mesopotamia and of Australian members of the "Dunsterforce" in Persia. All the sections make inspiring reading, but for the most part they have little to say about the air. The work of the Australian Flying Corps was recounted in a previous volume. One appendix does, however, give all the evidence collected in order to support the claim that Baron Manfred von Richthofen was killed, not by the Canadian, Capt. Roy Brown, but by an Australian machine-gunner, Sergt. C. B. Popkin. The evidence of numerous eye-witnesses on the ground is quoted to show that after Capt. Brown had desisted from his attack (evidently believing that he had killed Richthofen) the Baron pursued Lieut. May for another mile, following all his turns and firing at him, that he then left him, went into a steep right bank, and so flew over Sergt. Popkin, who fired at him and believed that he killed him. The official *War in the Air* accepts the version that Brown fired the fatal shot.

One more contact with the air is noted, in the section dealing with Mesopotamia. In the final fighting we read that possible reinforcements to the Turkish army were kept away by a night force under Brigadier-General A. C. Lewin, C.B., C.M.G., D.S.O. Who would then have thought that nineteen years later Gen. Lewin would come in a good second in a King's Cup air race?

Precision-ground Bars

THE English Steel Corporation, Ltd., of Vickers Works, Sheffield, has issued a new list of steels supplied precision-ground, centreless-turned, or cold-drawn.



WESTERN TERMINAL : An aerial view of the present buildings at Whitchurch, Bristol. The clubhouse is in the centre (to the right of the large hangar) while the control and customs building is beside it. In due course the latter will be transferred to the opposite end of the landing area. (*Flight* photograph.)

PRIVATE FLYING

Topics of the Day

Experience Value

ONCE upon a time, when my logbook total was even less than it is now, I used to excuse my apparent imprudence (in saying what I thought about different light aeroplanes) by explaining that I was an amateur writing for amateurs. In other words, if I found certain difficulties with certain aeroplanes, then these were probably just those difficulties which would face ninety per cent. of the prospective owners. A super-expert, such as a real test pilot, simply would not look on them as difficulties in any sense of the word.

Well, I still think that the best light aeroplane is likely to be one which has been designed and test-flown by an amateur pilot; that the world is too full of pseudo-experts who have flown an incalculable number of hours on conventional aeroplanes and are thoroughly frightened by, and critical of, innovations; and that these pseudo-experts have done more harm to the movement than anyone else. Unfortunately—though I still blush when I look at my logbook and become the model of caution when I am flying a strange type—it is to be supposed that I shall soon be entering this same pseudo-expert class, purely on a number-of-types-flown basis.

Therein lies my salvation, maybe. After an initial concentration on Moths, Avians and Cadets I have never flown any single type—with the exception, perhaps, of the Hornet and Whitney Straight, two very different aeroplanes—for a sufficient length of time to become superior about it. Every flight, in fact, is a separate adventure; every different aeroplane is approached with humility and handled (I hope) with requisite care, on the principle that the best-tempered dog can be made to bite if there is sufficient provocation.

Fault Finding

ALL of which is merely a preliminary to a startling and probably ridiculous suggestion: That professional test and demonstration pilots should, through some arrangement or other, be able to go the rounds for a fortnight or three weeks every year and fly as many different types as possible while doing, in fact, a job of work for each firm which is visited.

Unless I am very much mistaken, the breeds would be immeasurably improved within two years if such a scheme could be made practicable. Little faults which are part and parcel of a particular manufacturer's range would be eradicated and there might even be a general standardisation of flying characteristics and control arrangements.

This standardisation is, of course, already apparent to some degree, but, in the civil world, we still suffer aeroplanes which have apparently been designed by dwarfs for dwarfs, by giants for giants and by three-armed men for three-armed men. One day we might even encourage test pilots to fly in the passengers' seats, and ask well-upholstered manufacturers to effect entry into one or other of their products. One or two of these manufacturers just couldn't get into them at all, or would, at least, cause immense instrumental and sartorial damage at every entry.

Presumably Martlesham and the pilots of the squadrons to which experimental aeroplanes are lent see to it that military types come up to scratch from the pilots' point of view, but even the manufacturers of military aeroplanes might gain something, or at least save money, as a result of such an arrangement. I don't know. While admiring them for the beauty of their structure and performance, and wishing that we had as much money to spend in the civil world, military aeroplanes are, to me, just so much killing machinery; dangerous junk as far as human progress is concerned and a great, if necessary, waste of good brains and material. The Japanese bombings have, unhappily, shown us how the human race is to-day making use of its mechanical ingenuity; I trust we shall grow up in a couple of million years or so. Military objectives, my foot! We're all military objectives, and very messy ones at that after the raid has passed over.

Night Flying

LAST week I said, apropos night flying training costs, that if I was wrong somebody would tell me and "we should all be that much wiser."

My small store of wisdom is already increasing. One instructor tells me that in the winter months "B" licence aspirants sometimes have to wait as long as six weeks before the weather is sufficiently good for the Lympne-Croydon trip. That seems to be a long time, and I suppose they were waiting for the really perfect weather which would not be quite so necessary with proper equipment.

Nevertheless, I retract my "two or three days every week" as far as depth-of-winter flying with ordinary aeroplanes is concerned. The "two or three days" would apply to aerodrome flying, but not to cross-country work.

In the matter of weather, incidentally, I can hardly think of any two more difficult areas to be coupled together in a night flight than London and the South Coast. When the inland area is good the coastal area is bad, and vice versa. Anyway, I make no bones about the confession that I should want *very* good weather at each end before I set off in the middle of the night. But there, I'm unusually timid.

INDICATOR.

FROM the CLUBS and SCHOOLS

EDINBURGH

It was a quiet week owing to the wind. Visitors included Viscount Forbes in a Rapide, Captain Prior Farmer and Mr. Dumas, both in Hornets, and Mr. Hopkinson, M.P., in a Miles Hawk.

HANWORTH

Unsympathetic weather kept flying times comparatively low last week, the actual total being 85 hr. 25 min. Mr. Chubb went solo.

MIDLAND

Mr. A. J. Lambert passed his "A" licence tests last week, during which the Club logged 20 hr. 5 min. dual and 13 hr. 30 min. solo and passenger.

LONDON

Mr. G. Sundblad has completed his "A" licence tests and Messrs. J. Kugan and C. E. Scrutton have gone solo. Last week's flying time was 71 hr. 15 min.

RAND

First soloists during August were Miss M. Goldsmith, Mr. A. Pumfrey, Mr Walmsley and Mr. W. Booth. The total flying time for the month was 340 hr. 54 min.

PERTH

With improved weather the flying times went up to 25½ hours for the week ending September 20. Mr. Scarlett made a week-end trip to Peterborough in the Swallow.

YORKSHIRE

Club aircraft flew 56 hr. 20 min. last week, visiting Cranwell, Norfolk, Birmingham, Thornaby and Filey. Mr. H. Heaton, of Leeds (Aviation Group Member) has passed his "A" licence tests.

C.A.S.C.

Last week-end members flew 17 hr. 5 min. at Fen Ditton. Six members flew cross-country to Hatfield. Mr. R. T. Saunders has made his first solo and Mr. R. Heyde has joined the Corps No. 1 Squadron.

BORDER

The more or less good weather continues to allow a certain amount of cross-country flying to be done, and the aerodromes visited last week included Leamington, Doncaster, Newtownards, Newcastle and West Freugh. Two machines attended the air rally at Newtownards, and Mr. M. Thomson, in the Hornet, collected the prize for the arrival competition. Several soloists are taking advantage of the good weather to pass their "A" licence tests.

KARACHI

Of the 249½ hours' flying done during August, 97 hr. 2 min. represented dual and 152 hr. 10 min. solo. H.H. the Maharaja Kumar Sahib Daljitsinghji of Idar State qualified for his "A" licence after a very short period of instruction. On August 21 the Aero Club of India and Burma borrowed the Club premises to entertain H.E. Sir Lancelot Graham, Governor of Sind, prior to the presentation to Mr. P. D. Sharma of the Willingdon Trophy.

SOUTHEND

In spite of poor weather flying times were satisfactory last week. Mr. J. Alexander and Mr. W. A. R. Keddie passed their "A" licence tests. One of the Club members, Mr. D. C. Howell, has become the owner of a B.A. Eagle. Mr. F. Wallace has completed the first of his "B" licence cross-countries. A club dance will be held on October 2 and a whist drive on the 8th. Both are at 8 o'clock. All visiting pilots and friends are welcome.

YAPTON

Rain and high wind have reduced opportunities for flying very sadly and only 23 hr. 15 min. were logged for the week ending September 25. First soloists are J. C. Howard, J. R. Hutton, A. F. Rowland and J. G. May. Messrs. Rowland and May have passed their "A" licence tests. Walter Neusel, the Germany heavyweight boxer, has been a visitor to the Club and took some dual instruction, in spite of the fact that he was hardly able to get into a Moth.

BENGAL

During August the Bengal Flying Club flew 52 hr. 25 min. dual and 15 hr. 35 min. solo. The Raja of Katiyari has been doing a good deal of flying and is progressing rapidly towards his first solo. Mr. G. M. Scott has passed his "A" licence tests and Mr. R. P. Dargalkar, chief pilot of the Majurbhanj State, has completed his blind-flying tests. On Saturday, September 4, a special flying display was staged as a farewell to H.E. Sir John Anderson, the retiring Governor of Bengal.

JOHANNESBURG

Flying hours for August were 569, which is greater by 113 than the total for July. One new pupil was enrolled (Mr. Nicolson), Mr. Milligan and Mr. Meiring obtained their "A" licences, and Mrs. Martin, Messrs. Ascham, Nicolson and Marx performed their first solo flights. Two new Tiger Moths have been added to the Club fleet, which now consists of twelve aircraft. Of this number four are allocated to the Government Training Scheme and the balance are available for the use of Club members.

CAMBRIDGE

Flying times at Marshall's Flying School for the week ended September 26 totalled 72 hr. 40 min. Mr. Pendse went solo and passed the tests for his "A" licence the same day. Mr. Gallyon also passed the "A" tests.

HERTS AND ESSEX

New members during the past fortnight were Messrs. F. A. Reedtz and H. Moller (Denmark), N. Watson, R. A. Peet, S. G. Hunter, D. C. Friend and A. J. Barrett. Messrs. Cather and Blackaller accomplished "B" licence cross-country flights, and Messrs. Wood, Aldous, Lee, Hyland and Moller completed the "A" licence tests. Flying times totalled 164 hr. 46 min.

BROOKLANDS

Nine candidates are studying for the Second Class Navigator's Certificate under Mr. Robert Ashton, and Mr. C. A. Nepean Bishop is taking a course of instrument flying. Mrs. Duncan and Messrs. L. H. Clark and Lymposs have gone solo, and Messrs. Cope and Ireland have passed their "A" licence tests. Next Sunday there will be a demonstration of petrol-driven model landplanes and seaplanes by the Society of Model Aeronautical Engineers.

YORK AND LEEMING

New members are Dr. Morris, Mr. W. Wormald, Mr. Gillson, Mr. Armstrong. A club dance is being held at Betty's Café, York, on Friday, October 1, in conjunction with the North Yorkshire Automobile Club. Yorkshire Aviation Services hope to have a Cadet available for the use of members early in November. This will bring the number of machines up to eight. Lt. King Clark has just flown his Miles Whitney Straight home from Egypt. Mr. Headlam, another private owner, has taken his Whitney Straight out to Biarritz. The flying time for the month to September 18 was 71 hr. 20 min.

NEWCASTLE

There have been many expressions of regret among members following the announcement that Mr. H. Mitchell, who has been chief instructor for the past two years, is leaving at the end of this month. "Mitch" has been a popular figure at the Club and his genial presence, both in the front seat and in club rooms, will be missed. He is taking up another appointment and will carry with him the good wishes of all. A total of 32 hours were logged during the week in spite of several bad deals by the Clerk of the Weather, and Mr. H. Stafford completed his "A" licence tests.

CINQUE PORTS

Last week was yet another of intense activity and 74 hours' flying were recorded. Most of these represented dual, so both instructors have been spending most of the daylight hours in the air. First solos were made by Mr. C. T. Twentyman and Mr. D. Middleton; Mr. Twentyman also passed his "A" licence tests. A large party from Lympne attended the South Coast Flying Club's annual dinner at Shoreham last Saturday night. Visitors to the Club included Flt. Lt. Barringer, of Percivals, in a Vega, Brian Allen in a new Stinson, and Mr. Sydney St. Barbe in his "Sky-Writing" Hawk. The sales department has disposed of a B.A. Eagle to Mr. Howell.

Brighton Frolics

As one would expect of an organisation allied to the Brooklands and Lympne Clubs, the South Coast Flying Club knows how to enjoy itself—and to make its guests do ditto.

The annual dinner and dance, at the Grand Hotel, Brighton, last Saturday, was on the right lines from the very outset, which is to say that everybody, except the *haut monde* at the top table, could sit just where he or she liked—a very excellent plot that has advantages over the Say-where-you-want-to-sit-when-you-apply-for-your-tickets scheme, and is infinitely preferable to the sit-where-you're-put, or isolationist, policy favoured by some clubs.

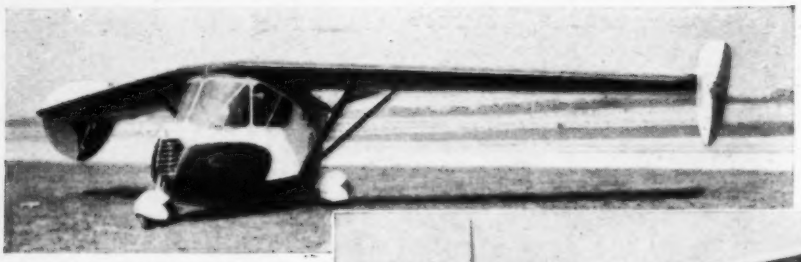
Nor was there an excess of verbiage. Mr. Haddock, the chairman, who welcomed the guests, started his speech with a reference, made in the most sympathetic and nicest possible way, to an unfortunate accident which had just robbed the club of one of its keen members, Mr. Tarrant. Continuing, he limited his bouquets to those who really deserved them—people like Mr. C. A. Pashley (cries of "Good old Pash!"), the chief instructor, who has been steadily teaching people to fly for the last twenty-seven years, man and boy. To us, that suggests a sort of earthly perdition, but Mr. Pashley looks so well on it that we will refrain from commiserating with him. Mr. Haddock likewise raised a hearty cheer for the Davis team—Bill, Mrs. Bill and Duncan.

Flt. Lt. Tommy Rose responded to the toast. To that remark, of course, nothing remains to be added, except that he told the most delightfully libellous story about somebody who (as a friend of ours would have said), libellous stories didn't ought to be told about.

After that there began the serious business of the evening, among which was dancing.

Private Flying

The Trend Toward "Trikes"



The Waterman Arrowbile (above), the Gwinn Aircar (right), and the Waco Model N (below) typify the present American trend toward three-wheeled undercarriages. Each of these machines is offered as a practical private-owner type, the Waco being regarded as an addition to the standard range, which might indicate that the manufacturers intend to sound—

—public opinion before standardising the tricycle gear. The Waterman is being handled by the Studebaker concern and mounts the four-in-line Menasco. A Pobjoy powers the Gwinn and the Waco—a four-seater—has one of the new Jacobs radials It seems that there is scarcely an American manufacturer who is not designing or building machines with a nose wheel. The tricycle arrangement has been adopted by Douglas for the D.C.4 and also figures on a new twin-engined Timm transport.

The Hughesdon-Desmond Wedding

THE marriage took place last Thursday of Mr. Charles Hughesdon to Miss Florence Desmond. Among the guests at the reception were Lt. Col. J. T. C. Moore-Brabazon, M.P., Mr. and Mrs. F. G. Miles, Flt. Lt. and Mrs. Tommy Rose, Wing Cdr. J. D. Woodhouse, Mr. Whitney Straight, Mr. C. R. Chronander, Mr. J. J. Waddington, Mr. Grahame MacKinnon, Dr. and Mrs. Miles Bickerton and Capt. A. G. Lamplugh.

The Women's Engineering Society

CONTRARY to what might have been deduced from references in the "popular" Press, there was a good deal of sound sense talked when the Women's Engineering Society held their annual dinner at the Forum Club, London, last Saturday. During the morning Miss Dorothy Spicer had delivered a paper to the Society on the "Selection and Treatment of Steels for Aero Engines," and Miss Pauline Gower on "Ice Formation on Aircraft in Flight."

At the dinner, which was attended by many people distinguished in various spheres of engineering and industrial administration, and at which the Technical Group of the Forum Club were guests, Miss Amy Johnson, C.B.E., was in the chair. Lt. Col. Sir Francis Shelmerdine, C.I.E., O.B.E., Director General of Civil Aviation, who was accompanied by Lady Shelmerdine, proposed a toast to "Women in Aviation," giving a brief survey of the part they had played since the early days. He mentioned also that quite a number of them had caused him a lot of worry and involved him in considerable expense on behalf of the Government. He reminded his hearers that Miss Amy Johnson was the first woman to hold a Ground Engineer's Licence, and he felt that there was a great future for women in aviation. He praised Miss Spicer for the number of G.E. and flying licences which she holds.

Miss Amy Johnson (retiring president of the W.E.S.A.), replying to the toast, managed to strike a pleasantly informal and personal note by her references to various people present.

Miss Caroline Haslett, C.B.E., hon. secretary, proposing "The Guests," also imparted much interesting information about those present. Miss Hilda Martindale, C.B.E., former Deputy Chief Inspector of Factories, replied to the toast.

Recipe for Record-breaking

"Playboy of the Air." By Jim Mollison. 10s. 6d., Michael Joseph, Ltd., Henrietta Street, London, W.C.2.

THIS "candid confession" is valuable, if only for one thing—that it shows a type of mental equipment that is apparently desirable for the record-breaking pilot. If the author is to be believed, the ideal method of going a long way in a slow aeroplane in a short time is to conceive the whole flight in a sardonic spirit; to preserve a good measure of contempt for the public whose interest has made the flight profitable (for no one pretends that the makers of Ovitabo hand out their bonus purely in order to further the cause of aviation); and to alternate glances at the instruments with swigs at the brandy bottle.

We don't disagree; it is doubtless a very easy and pleasant way of tackling a formidable task. It only seems odd that there have been so many other good record-breaking pilots, male and female, who have a different recipe.

The book is capably written:

> We were not talking, only writing curt notes to one another. Impossible to talk in a world of inescapable noise and everlasting grey water beneath.
>
> Our senses were dulled. We drank black coffee to keep awake, swung legs and arms as best we could to keep warm. Amy's blonde head lay against the rattling windows in weariness. Our lips were dry and we smelt petrol. Barley sugar helped.
>
> Sandwiches. Coffee. Sandwiches. Coffee. Was it a hundred years ago we walked safely and quietly on dry land?
>
> Instruments jumping on a shaking panel until my eyes ached watching and calculating. Compass, oil pressure, rev counter and the petrol gauges. . .
>
> Maps, protractors, pencil-stubs, screwed bits of paper. Twenty-six hours. Twenty-eight. Twenty . . .
>
> "Icebergs," wrote Amy.

There is not enough of this sort of thing in the book; yet it is so much more engrossing than the playboy's conquests in other spheres.

COMMERCIAL AVIATION

THE WEEK AT CROYDON

Getting Used to QBI Again : Bits of Extra Service : An "A" Licence Record? : Indoor Sports

WE had a real foretaste of winter last Friday, when QBI was the order practically all day, and when such countries as Belgium and Holland were frequently impossible and always difficult to arrive at. The various companies' winter schedules, with reduced numbers of services, do not come into force until next Saturday, October 2 (the date when "right October ale" used to be on tap), so the control tower had a fairly hectic time on Friday, though little real difficulty was actually experienced.

Services tend to "bunch" around certain times of day which are important for various commercial reasons, but there is little difficulty in sending off a number of machines scheduled to depart at the same or approximately the same moment unless there are aeroplanes due to arrive at the same time, in which case those on the ground have to wait for those in the air. Otherwise there is nothing against sending four or six machines away in fairly rapid succession, even in QBI, such is the close co-operation between Control and the companies in this respect.

Imperial Airways, not content with introducing the very snappy snow-white overalls with blue and gold shoulder-straps for captains' and crews' summer wear, which look so very smart on tall, thin officers if not quite so impressive on short, plump ones, have recently introduced a new sartorial note to the Airport. Two small, smart page-boys in dark blue with gold buttons and with pill-box hats, have suddenly appeared on the scene. Historically, their kit, but for straps under the boots, spurs, a cavalry whip and a large drooping moustache, is that of the trooper in walking-out dress in London of the 1890's. Their activities in giving passengers that little bit of extra service are already obviously appreciated, and I shall be surprised if others don't copy it. If I remember right, Daimler Airways, Ltd., employed page boys on the aeroplanes at a time when every ounce of weight was important.

His Master's Voice

Owing to car-parking difficulties, the companies are asked not to encourage their passengers to leave motor cars at the Airport whilst away on air trips. Certain opulent people especially seem casual about leaving cars lying about, and there was a story here of a dance-band leader who left some diamond-studded monster right in the fairway with the doors locked and the wireless on. There the faithful creature sat for a good ten days [What a battery!—ED.] relaying its master's voice—very Oxford—from a foreign station, and, thanks to our innate honesty and the fact that the police kept a shrewd eye on the car, its owner found the gold knobs all on after a fortnight's absence.

Last week Mr. Oliver Stanley, President of the Board of Trade, flew to Copenhagen, followed next day by Dr. Burgin, Minister of Transport. Their objective was the new two-mile British-built Storström Bridge between the islands of Zealand and Falster, which was being opened by King Christian of Denmark.

Talking about the Ministry of Transport, the latest victim of high-speed motoring on the unrestricted "race track" down Purley way past the Airport gates was a somewhat unusual member of the Airport fauna. It was a grey squirrel which, for reasons not easy to imagine, was scampering around C hangar, under and over motor cars, and which then traversed the public enclosure and attempted to cross the main road. Not being a trained member of the aerodrome staff, its agility was not equal

to the task, and it succumbed to the passing traffic. The next victim may be a typist in a squirrel coat, who, unlike the squirrel, will be incapable, at a pinch, of climbing a Belisha or Burgin beacon. Not that it would have helped the squirrel even if he had thought of it, for there are no pedestrian crossings down the race track.

Olley Air Service has specialised lately in ambulance cases, with special stretchers, exceptionally comfortable invalid beds designed to fit the machines, and careful training of ground staff and flying personnel to give the maximum specialised service in the air and on the ground. Recent invalid flights undertaken by this company included one between Trieste and Lauzanne.

Some people have an amazing aptitude for learning to fly quickly, although, of course, a very great deal depends on the instructor. An astonishing case happened recently under Capt. Hancock, of Surrey Flying Services, when a young Harrovian (are our Public Schools decadent?—*vide* cheap daily Press) accomplished an admirable first solo after only four lessons totalling two and three-quarter hours. Having done his solo, the young man hurried back to school, it being the last day of the holidays.

I am told that in the luxuriously appointed pilots' room of one firm at Croydon there is every inducement towards those manly sports about which the National Fitness Campaign people are so keen. What with darts boards marked out in gold wire, and shove-ha'penny outfits of Parian marble, and a subscription of only a tanner (which may, perhaps, include the club tie), the pilots of that particular concern should be the fittest in the land. A. VIATOR.

New G.A.P.A.N. Master

THE Marquess of Londonderry, K.G., former Secretary of State for Air, has been appointed Master of The Guild of Air Pilots and Air Navigators of the British Empire. He succeeds the late Capt. The Rt. Hon. F. E. Guest, M.P., who, like Lord Londonderry, was an Air Minister and a pilot, and who held the appointment until his death earlier in the year.

Lord Londonderry has taken the keenest interest in the practical side of flying and was, in fact, the first Air Minister to take a blind-flying certificate, and he is now studying for his "B," although he will not be able to sit for it since he is over age.

Commercial Aviation

SIMPLIFYING ASTRONOMICAL NAVIGATION

Points of the New "Air Almanac" Described with Examples and Comparisons

H.M. Nautical Almanac Office has, on behalf of the Air Ministry, prepared (and issued on September 28) a special almanac intended for the use of airmen who practise astronomical navigation. The idea of an air almanac is not new—the U.S.A. Nautical Almanac Office published one in 1933 as an edition distinct from the version intended primarily for the use of seamen. However, in 1934 the two editions were reamalgamated, with minor modifications. France also published an air almanac in 1936.

The ideas underlying the issue of the *Air Almanac* are those of simplification and of reducing the amount of work to be done by an air navigator who wishes to determine the Local Hour Angle (the angular measure, either in arc or in time, between the celestial meridians of the observer and the heavenly body) in order to be able to work out an astronomical spherical triangle. The latter part of the work he is able to do by a variety of existing methods, either "quick" or "long"—i.e., by calculation, by the use of special tables, by the use of graphical methods, or by the use of computing machines.

This almanac is consequently arranged and produced with the main object of assisting the rapid determination of the Local Hour Angle. To quote from the "Explanation" on page 10:

> "The air navigator, working in poor conditions in a fast-moving aircraft and to only one-tenth of the accuracy obtained with a marine pattern sextant, requires his astronomical data directly in the form in which he wishes to use it. Moreover, the necessary interpolations must be simple, reference to other pages must be reduced to a minimum, and yet the information must be given in a light, compact and easily readable form."

The method by which this desideratum has been attempted is indeed ingenious, and the N.A. Office is too modest about an immense undertaking which has been so quietly and efficiently carried out.

The almanac itself is made up of two portions, a "permanent" cover and interpolation tables, and "loose leaf" sheets containing ephemeral data for two days. These sheets are at present published at intervals of three months, but this period will be extended to six months, and eventually to twelve. The clip for insertion of its sheets appears weak at first sight, but it is understood that it will last for 400 openings, and that the clips holding the loose sheets are interchangeable with it, so that even if it breaks is can easily be replaced.

Particularly striking features of the *Air Almanac* are:

(1) The sun, the moon, the 4 chief planets and 50 stars are tabulated in Greenwich Hour Angle ("G.H.A.") in measure of arc. By applying longitude (again in measure of arc) the Local Hour Angle ("L.H.A.") is found, in arc.

(2) Interpolation tables have been reduced to a minimum, are accessible and easy to read.

(3) By the ingenious system of detachable sheets, each of which contain ephemeral data for two days, "hunting" through the book is eliminated, and the possibility of error from this cause reduced.

(4) Last, but by no means least, the adoption of the G.H.A. system enable all L.H.A.s to be worked out in an exactly similar manner for all types of heavenly bodies, and a common "quick-working" form can be used. Mental strain in the air is thereby further reduced.

Below are given a few examples which will give some idea of the way in which the work of obtaining the L.H.A. has been reduced. Comparison is also made between the Admiralty *Abridged Nautical Almanac*, from which is obtained the L.H.A. in *time*, and the *American Nautical Almanac*, from which is obtained the L.H.A. in *arc*. The latter publication is quoted as a matter of interest, since the U.S.A. authorities adopted the G.H.A. system some years ago, and many British air navigators have been using the *American Nautical Almanac* in default of any corresponding British publication. The American almanac is, however, used by both seamen and airmen; its arrangement, therefore, differs in many respects from that adopted for the air almanac published in this country, as seamen require greater accuracy for their navigation.

Fewer Operations

The process of finding, by means of the *Air Almanac*, the L.H.A. of the moon and of any one of the four planets tabulated (Venus, Mars, Jupiter, Saturn) is similar to the method required for finding that of a star, three additions giving the G.H.A.

The three quantities are quite easy to find in the *Air Almanac* in view of its arrangement. In each case two further operations are saved over the *Abridged Nautical Almanac* method, owing to overcoming the necessity of further correcting the R.A., i.e., in order to find the L.H.A. a total of six operations is required against thirteen. The interpolation of the declination of the heavenly bodies whose declinations change rapidly is facilitated by "critical" tables, which give the answer to the nearest minute.

Throughout the *Air Almanac* an accuracy only to the nearest minute is attempted; this accuracy is, of course, quite sufficient for air work in view of the instrumental errors involved in taking the actual sights.

In addition to the data tabulated for the sun, moon, planets and stars a simplified Pole Star table is available for determining the latitude, and in the back pages of the cover there are to be found tables for correcting the Observed Altitude for Moon's Parallax-in-Altitude, Refraction and Dip. Tables of Sunrise and Moonrise, etc., are not included; these are published separately, reprinted from the *Abridged Nautical Almanac*, and can be inserted in the pocket at the back if required.

E. H. D. S.

EXAMPLES AND COMPARISONS

NOTE.—The mental operations required are indicated by figures on the left, e.g., (1), (2).
The book openings necessary are indicated by letters on the right, e.g. (a), (b).
The readings from the Tables are indicated by italic figures after the letters, e.g. (b *i*). (b *ii*).

Sun sight. Required the L.H.A. of the sun at $16^h\ 25^m\ 31^s$ G.M.T. on 24.11.37, in Longitude 86° 34′ W.

AIR ALMANAC.		AMERICAN NAUTICAL ALMANAC.		ABRIDGED NAUTICAL ALMANAC.		
(1) (G.H.A., 16^h) ... 63° 19′ (a)		(1) (G.H.A. 16^h) ... ... 63° 19.1′ (a)			h. m. s.	
(2) (G.H.A., $25^m\ 31^s$) ... 6 23 (b)		(2) (G.H.A. 25^m) ... 6 15.0 (b *i*)		(1) G.M.T. ...	16 25 31	(2) ("E," 16^h)... 12 13 16.3 (a)
		(3) (G.H.A. 31^s) ... ... 7.8 (b *ii*)		(5) Long W. ...	5 46 16 (c)	(3) ("E," $25^m\ 31^s$) −.3 (b)
(3) Sum = G.H.A. ... 69 42		(4) Sum = G.H.A. ... 69 41.9				
(4) (Add) 360 00		(5) Add 360		(6) L.M.T. ...	10 39 15	(4) "E" ... 12 13 16
				(7) "E" ...	12 13 16	
(5) (Sum) 429 42						
(6) Long. W. ... ... −86 34		(6) Sum 429 41.9				
		(7) Long W. ... ... — 86 34		(8) L.H.A. ...	22 52 31	
(7) L.H.A. 343 08					(=343° 08′)	
		(8) L.H.A. 343 07.9				

Star sight. Required the L.H.A. of FOMALHAUT at $01^h\ 33^m\ 13^s$ G.M.T. on 25.11.37, in Longitude 56° 31′ W.

AIR ALMANAC.		AMERICAN NAUTICAL ALMANAC.		ABRIDGED NAUTICAL ALMANAC.		
(1) (G.H.A. ♈ $01^h\ 30^m$) 86° 05′ (a *i*)		(1) (G.H.A., 25th Nov.)... 79° 57.5′ (a)			h. m. s.	
(2) (" " $3^m\ 13^s$)... 0 48 (a *ii*)		(2) (" $01^h\ 33^m$) ... 23 18.8 (b *i*)		(1) G.M.T. ...	01 33 13	(2) ("R," 00^h)... 04 14 04.2 (a)
(3) S.H.A. ... ... 16 26 (a *iii*)		(3) (" 13^s) ... 3.3 (b *ii*)		(6) Long. W. ...	−3 46 4 (d)	(3) ("R," 01 33) 15.3 (b)
(4) Sum = G.H.A. ... 103 19		(4) Sum = G.H.A. ... 103 19.6		(7) L.M.T. ...	21 47 09	(4) Sum = "R" 04 14 19.6
(5) Long. W. ... ... −56 31		(5) Long. W. ... ... −56 31		(8) "R" ...	04 14 19.6	
				(9) R.A.M. ...	26 01 28.6	(5) R.A. ...=22 54 15 (c)
(6) L.H.A. 46 48		(6) L.H.A. 46 48.6		(10) R.A. ...−	22 54 15	
				(11) L.H.A. ...	3 07 13.6	(=46° 48.4′)

Java—Celebes

FOR some time K.N.I.L.M. have been planning a service between Java and Makassar, in the Celebes, over five hundred miles of sea. Government approval has been obtained and the Celebes service has now been started. Douglas D.C.2s will leave Batavia for Sourabaya and Makassar every Monday.

Those New Regulations

TO-MORROW is the day on which the new regulations concerning lap straps, instruments and oxygen, details of which have already been given in *Flight*, come into force.

At the same time a *Notice to Airmen* reminds everyone that machines with a normal C. of A. must not be flung about or even spun. Official trials of machines in this category include tests to ensure that they will not inadvertently go into a spin, but do not include tests to check the spinning characteristics. Life becomes more dangerous every day for the poor owner, who must now carry out his own spinning tests.

Exhibition Train

THE Imperial Airways exhibition train continues to move on. To-day it will be at Glasgow Central Station, and the itinerary until the end of October is as follows:

Edinburgh (Princes Street), October 4-6; Newcastle (No. 5 platform, Manors North), October 8-9; Sunderland (Monkwearmouth), October 12-13; Middlesbrough (Loading Dock, passenger station), October 15-16; Harrogate (No. 3 Dock Line), October 19-20; York (Old Station), October 22-23; Hull (Collier Street, No. 1 Dock), October 26-27; and Leeds (Horse Dock), October 29-30.

Across Again

LOOKING at volumes of *Flight* for the 1919-1922 period we remember that the London-Paris and similar services were duly recorded and remarked upon. In due course they became so usual and so regular that further attention was unnecessary.

The same principle will apply to the Atlantic services and we record yet another crossing by *Caledonia*. She left Botwood at 9.53 p.m. (B.S.T.) on September 24 and arrived at Foynes at 9.31 a.m. Her average speed was 176 m.p.h., and Capt. Wilcockson flew at 13,000 ft. for the first six hours, and later at various heights down to 3,000 ft., in order to obtain, weather permitting, the best advantage from the following winds. At such heights celestial observations could be satisfactorily made. *Cambria* has also made her return trip in record time after the wing-tip float damage had been repaired. Her time was 10 hr. 33 min.

Meanwhile, it has been announced the *Lieutenant* will not, after all, be making North Atlantic flights. Apparently her range is not considered by the French Air Ministry to be sufficient for safety. We await official confirmation of the facts.

Australia and the Empire Plan

NOW that Mr. Hudson Fysh, the managing director of Qantas Empire Airways, is in this country with the purpose of settling the final details of the Australian section of the Empire air route, it has been possible to clarify one or two points in the plans.

The new scheme, in fact, automatically involves a very considerable pooling of control, equipment and personnel. Eventually Qantas will own a certain section of the Empire boat fleet and the through services will be operated by them and by Imperials in approximate proportion to the relative distances covered by the two companies. Three pilots, including Capt. Lester Brain, the Superintendent, have already been taking a flying-boat course at Hamble, and four more are to come when they have returned to carry on the work. Mr. McComb, the director of ground services, is also over here and big plans are already under way for radio equipment or re-equipment throughout Australia.

Qantas will continue to run her inland service between Darwin and Brisbane, for the benefit of prospective passengers on that route, with the present D.H.86 equipment. And it may be mentioned in passing that, thanks largely to a first-rate maintenance system, this equipment has done remarkably good work, just as previous D.H. types have helped to build up Australia's air transport system. Australia, however, now demands metal construction and it is surely up to us, expansion or no expansion, to see that this demand is satisfied.

As already given in *Flight*, the flying-boat bases will probably be at Brisbane, Gladstone, Bowen (or Townsville), Karumba and Grooet Eylandt—additionally, of course, to Sydney and Darwin. Between Singapore and Darwin the question of bases is a matter of negotiation with the Government of the Netherlands Indies. Since K.L.M. (or K.N.I.L.M.) is undoubtedly flying through to Australia in due course, and since they already make use of much of our present Far Eastern equipment there should be few difficulties here.

Finally, there is the Tasman Sea link. New Zealand is a contributor towards the Empire service costs and we may be sure that the last gap will be bridged just as soon as the necessary equipment is available.

Belfast's Airport

A FEW details have already been given of Belfast's proposed land-sea airport at Sydenham, and it would seem that this will eventually be an outstanding example among air bases.

The Harbour Commissioners have now obtained a licence for the use of their reclaimed land, one of the outstanding features of the site being that it can be reached in seven minutes by car from the centre of the city. The present reclamation extends to 365 acres, of which over 100 acres are now prepared for landing. Extension of the landing surface is rapidly proceeding, and runways of 1,000 yards, with 1,500 yards in the direction of the prevailing wind, will be available. Even this, however, is not the full extent of possible extension. Should it become necessary, in order to meet the requirements of the larger aeroplanes of the future, further land will be reclaimed and a wide runway in the direction of the prevailing wind of 2,000 yards and over can without difficulty be obtained. At a future date flying-boat facilities will be available.

The aerodrome is particularly easy to find since it is situated within the confines of the city at the head of Belfast Lough and adjacent to the deep-water ship channel. Some care will, of course, be necessary in approaching from the city side in conditions of bad visibility owing to the presence of chimneys and cranes. Examination of the weather records, however, suggests that the incidence of fog is less than half that at Croydon and its clearance is noticeably more rapid.

The layout has been designed by Messrs. Chamier, Gilbert-Lodge and Co., and the work of preparing the landing area has been carried out in accordance with their designs and plans by the Harbour Commissioners' engineering staff. The design of the hangar, which is now nearing completion, and the design of the future airport buildings, are the work of Mr. H. Stavers Tiltman, while Messrs. Harland and Wolff are the contractors for the hangar. An Air Ministry decision on the subject of wireless facilities is shortly expected, and the Lorenz approach system has already been tested there.

The present licence extends to day flying only, but the necessary equipment for night flying is in process of installation, and it is anticipated that approval will be granted for night flying at an early date.

Meteorological

DIRECTLY or indirectly, the study of meteorology is the most important work in the development of air transport. Mechanically and electrically the commercial machine is, or will soon be, virtually beyond failure, but flying conditions can still be met which nullify this reliability and that otherwise perfect communication system. Such conditions are concerned nowadays not so much with poor visibility near the ground as with ice formation and electrical disturbances. To the Meteorological Office—and its co-operators throughout the world—therefore, we must turn for final regularity in air travel.

The *Annual Report of the Director of the Meteorological Office* for last year is of particular interest not so much on this account but because the year under review was a period of planning and preparation with the object of providing the greatly extended meteorological services required by the expanding R.A.F. and the increased amount of civil flying both in Great Britain and overseas. Additional officers were recruited and trained to staff the many new meteorological stations required on service and civil aerodromes in Great Britain and in connection with the Empire air routes. Of particular interest were the Atlantic problems, and in order to carry out a special programme of meteorological observations and investigation over the North Atlantic an officer has been attached to the s.s. *Manchester Port* for a year, making in all eight round voyages between England and Canada.

Considerable attention, too, has been given to the problem of the issue of warnings of the formation of ice, and these are now given in the regular reports transmitted from Borough Hill. With the idea of studying upper-air conditions a Met. Flight has been stationed at Duxford. This Flight has now been moved to Mildenhall and a second Flight established at Aldergrove, Ulster.

The *Report* is issued by H. M. Stationery Office.

HERE and THERE

A New Leo Boat

THE Air France flying boat prototype Lioré and Olivier 24-6 (four Hispano Suiza 12X engines of 690 h.p. each), destined for service on the Mediterranean routes, is nearing completion at Marignanne, near Marseilles. The services for which this machine has been specially built are the Marseilles-Algiers, Marseilles-Tunis and Marseilles-Beyrouth routes. It will carry twenty-four passengers, has a total weight of 30,800 lb., and its estimated top speed is 210 m.p.h. It is fitted with slotted flaps and variable pitch airscrews.

The Scarborough Tragedy

THE prevailing weather conditions at the Scarborough turning point during the King's Cup race were described by Cdr. L. G. D. Way, the R.Ae.C. official observer, when he gave evidence at the inquest at Scarborough on Wing Cdrs. P. C. Sherren and E. G. Hilton.

The wind, he said, was in the north. At 9 a.m. it was blowing at 25 m.p.h., with gusts, caused by the Castle cliffs, of 35 m.p.h. At 10 a.m. it was still in the north, but at 11 o'clock, just before the crash, it had veered slightly and was blowing at 35 m.p h., with gusts of 45 to 50 m.p.h. The machine approached the Castle walls at a height of about 150ft., hit a very bad bump, dived and crashed. He added that there was a "regular turmoil of wind."

The jury returned a verdict of "Accidental Death," and the coroner remarked that the country had lost two brilliant and experienced officers, one of whom—Wing Cdr. Hilton—had probably carried out more test flights than any other officer in the country.

Aluminium

SOME of the many forms in which aluminium is supplied by the British Aluminium Co., Ltd., (Adelaide House, King William Street, London, E.C.4) are illustrated in a new brochure, which also contains interesting views in the company's seven factories.

Power and Precision

A NEW sheet mill for stainless steel is to be installed at the Stocksbridge Works of Samuel Fox and Co., Ltd. The mill, it is stated, will be the largest of its kind in the country, and its rollers will run on four British Timken bearings, each weighing over 8,000lb. and with a load capacity equal to that of the world's largest bearings.

Constant-speed Airscrews

THE Warwick works of Constant Speed Airscrews, Ltd., a company formed to produce, under licence, the German V.D.M. airscrew, are now nearing completion. Several machines have been installed and the buildings are finished.

As mentioned recently in *Flight*, the V.D.M. constant-speed airscrew is electrically controlled by a motor remote from the airscrew, actuating the pitch-changing mechanism through a flexible shaft. Full details of the design have not yet been revealed, but on examination of an airscrew which has quite recently completed tests on a Rolls-Royce Merlin engine, the three feathering blades were seen to have full range from fine to coarse pitch. In the case of a failure in the operating mechanism, the blades are automatically locked in the existing position.

The spinner, which is shapely and quite small, has a very neat patented device for quick detachment. By the movement of a key, it is locked on or detached in a second.

A favourable point of design is the provision of a splined adaptor as a link between the airscrew boss and the constant-speed mechanism. This allows very quick and simple attachment or detachment of the airscrew itself without previous knowledge of the method.

It is hoped that production will commence at Warwick early next year.

The firm are the sole licencees of the airscrew for Great Britain and the Colonies.

A. E. Hagg Joins Napiers

IT is becoming increasingly evident that if the best possible results are to be obtained, very close co-operation between the aircraft designer and the aero engine designer is essential. Some of the firms in the British aircraft industry are in a fortunate position in this respect in that they have both an aircraft and an aero engine department. When that is not the case, the difficulty of ensuring close team work is increased.

News has just been received that, from to-morrow, Mr. A. E. Hagg will join D. Napier and Son, Ltd., in order to look after that particular aspect. During a very lengthy period as chief designer with the De Havilland Aircraft Co., Ltd., Mr. Hagg produced some very famous types of aircraft, and his share in the latest D.H. machine, the *Albatross*, is too well known to need stressing here.

It may be recollected that one of the unusual features of the *Albatross* is the ingenious type of duct cooling employed for the engines. Air enters through openings in the leading edge and is carried *forward* through ducts to the engines. This system was adopted because with the small frontal area of the De Havilland engines it was felt that overheating might take place while running-up the engines and taxying. As very small frontal area is also a feature of the Napier-Halford, Rapier and Dagger types, it is permissible to assume that Mr. Hagg will, among other things, give the firm the benefit of his experience of duct cooling in installations in which this type of cooling shows real advantages. It is, of course, a foregone conclusion that Mr. Hagg will be ready with advice on all installation problems, and altogether the new collaboration would appear to be a very promising one.

About Iran

"By Order of the Shah," by H. W. and Sidney Hay; Cassell and Co., Ltd., 15s.

WING-COMMANDER L. HOWARD-WILLIAMS, M.C., is one of the gifted authors of the Royal Air Force. He and Miss Sidney Cotton quite recently produced a book about Iraq (*Wings Over Eden*), and they have followed this up with the present volume about Iran. By the way, Iran is the old and the new name for Persia, and the "a" in it is long, as in "father." There is hardly any mention of flying in the book, which consists chiefly of interesting descriptions of motor journeys throughout the country, and of the chief cities visited. The book also contains much Iranian folk-lore and short accounts of the country's history and present-day conditions. It is an enjoyable book to read.

Forthcoming Events

October 2-18. Milan Aero Show.

October 6. R.Ae.S. (Weybridge Branch) Lecture: "Bird Flight," by Captain J. Laurence Pritchard. Vickers Works, 6.15 p.m.

October 14. R.Ae.S. Lecture*: "The Hafner Gyroplane," by Mr. R. Hafner.

October 21. R.Ae.S. Lecture*: "Practical Airscrew Performance," by Mr. F. M. Thomas.

November 4. R.Ae.S. Lecture*: "Problems of High-Speed Flight as Affected by Compressibility," by Mr. C. N. H. Lock.

November 16. Institute of Transport: Brancker Memorial Lecture: "Civil Aviation as a World Force," by Lord Sempill. Institution of Electrical Engineers, 6 p.m.

November 18. R.Ae.S. Lecture*: "The Take-off Problem," by Mr. H. F. Vessey.

November 25. C.A.S.C.: Dance, First Avenue Restaurant, London, W.C.1.

December 2. R.Ae.S. Lecture*: "Wing Surface Controls with Reference to Possible Developments in Flying Technique," by Flt. Lt. H. P. Fraser.

December 10. Strathtay Aero Club: Annual Ball, Salutation Hotel, Perth.

December 16. R.Ae.S. Lecture*: "Development of Sailplanes," by Sqn. Ldr. G. M. Buxton.

December 17. London Aeroplane Club: Dinner and Dance, Park Lane Hotel, London.

1938.

January 13. R.Ae.S. Lecture*: "Radio as a Direct Aid to Landing Approach," by Sqn. Ldr. R. S. Blucke.

January 27. R.Ae.S. Lecture*: "Electrical Ignition on Aero Engines," by Dr. G. E. Bairstow.

February 3. R.Ae.S. Lecture*: "Recent Research into the Aerodynamic Characteristics of Aircraft," by Mr. E. F. Relf.

February 17. R.Ae.S. Lecture*: "The Maintenance of Civil Aircraft," by Mr. H. L. Hall.

* All these lectures take place at the Institution of Mechanical Engineers, Storey's Gate, St James's Park, London, S.W.1, beginning at 6.30 p.m.

LIQUID COOLING TO-DAY

The Newest Aids in a Struggle for Supremacy —Liquid versus Air : High-temperature Systems and Ducted Radiators

An advanced Kestrel XVI installation in the new Miles trainer/general-purpose military monoplane. The coolant is ethylene glycol.

AMONG the more recent and beneficial contributions toward improved aerodynamic efficiency is the startling reduction effected in the cooling drag of air-cooled engines. Long-chord cowlings combined with carefully studied nacelle and fuselage shapes have permitted the attainment of vastly increased performance which has lately been further augmented by the introduction of "gill" devices for controlling the air flow. Were it not for these advances the air-cooled engine might by this time have been in a sorry plight; instead, designers of liquid-cooled engines are having their work cut out to make parallel progress.

Except in a few isolated instances (notably the Lufthansa machines with B.M.W. and Junkers engines), the employment of liquid-cooled power plants is exclusively military, the most highly developed installations figuring in our new Rolls-Royce-engined bombers and fighters. At the present time the foreign "liquid-cooled" situation is unusually interesting. In Italy, where the Isotta Fraschinis and Fiats have long been held in high regard, the position is similar to our own, with liquid- and air-cooled camps fighting a ding-dong battle; France undoubtedly recognises the merits of both classes of engine, but is suffering much disappointment; America, where liquid-cooling was so carefully fostered in the nineteen-twenties, suddenly went "flat out" on air-cooled development (largely at the instigation of the Navy and commercial operators, although the Army kept things simmering on the liquid-cooled side), and now, prompted by the outstanding success of our Rolls-Royce Kestrel and Merlin, is developing new liquid-cooled engines with all haste for installation in prototypes.

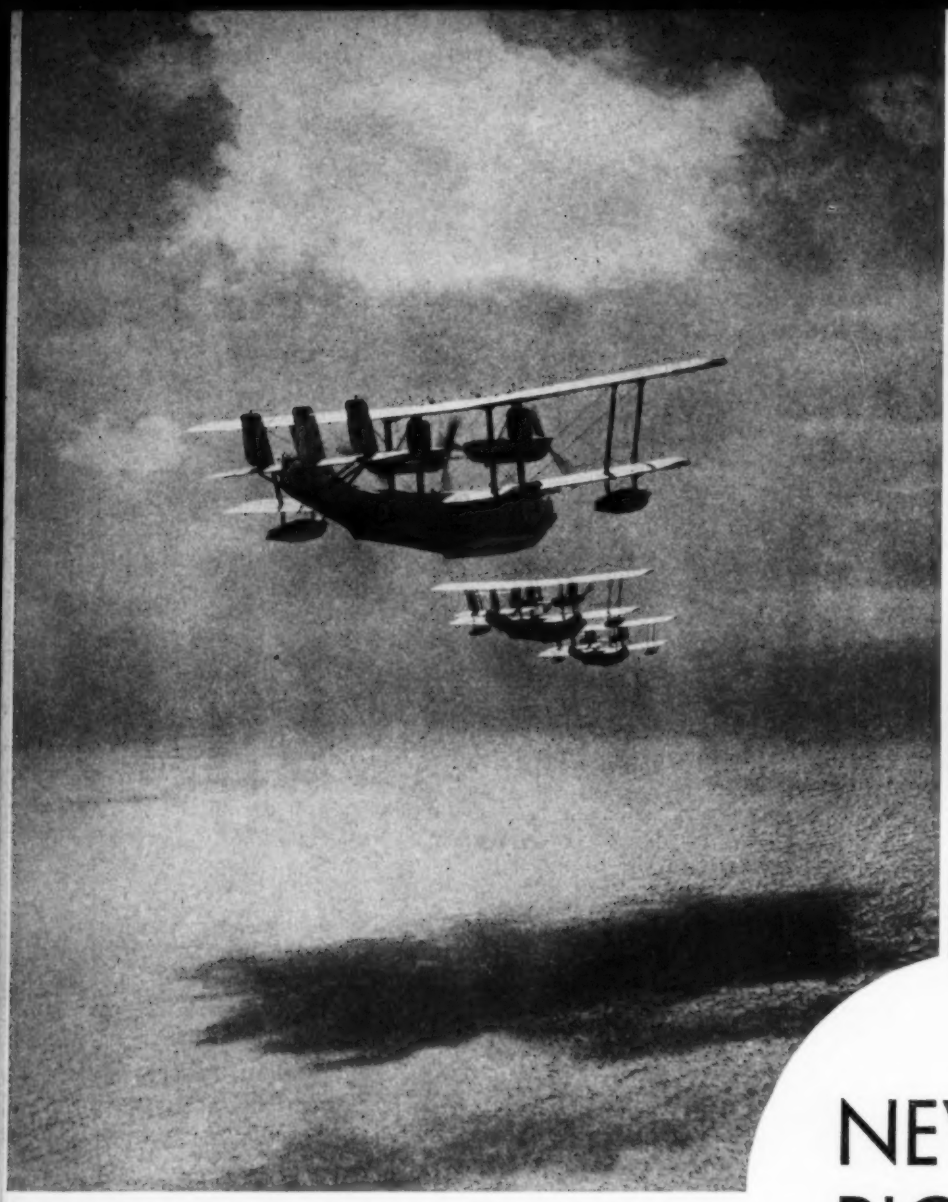
There is not the slightest doubt that in our own Rolls-Royce engines we have the most highly developed liquid-cooled power plants in the world, although America deserves a good deal of credit for her work with turbo-blower installations on the Curtiss Conqueror and Allison engines, the Lorraine and Koolhoven concerns for their development of the fuselage installation with shaft drive and twin airscrews, and Fiats for their work on "double" units as typified by the power plant of the Macchi-Fiat racing seaplane—the world's fastest aeroplane.

It is not proposed here to discuss the improvements which have been made in the design of indirectly cooled engines, but rather to outline the evolution of present-day practice in the installation and cooling of these units and the efforts being made in these directions towards obtaining the utmost efficiency in the fight against air-cooling.

In its simplest and best-known form the liquid-cooled engine uses water in the cooling system (though frequently the term "liquid-cooled" is used to denote chemical cooling as opposed to the use of water), the water being circulated round the jackets and heads by a pump, thence being transferred, with any steam which may have formed, to a vented header tank. It is then forced to the radiator, and so round again.

(Contd. after double centre page).

A number of experimental Rolls-Royce installations have been tried in this Heinkel He. 70a monoplane now based at Hucknall. This view shows it as delivered to this country last year. The engine is a glycol-cooled Kestrel.



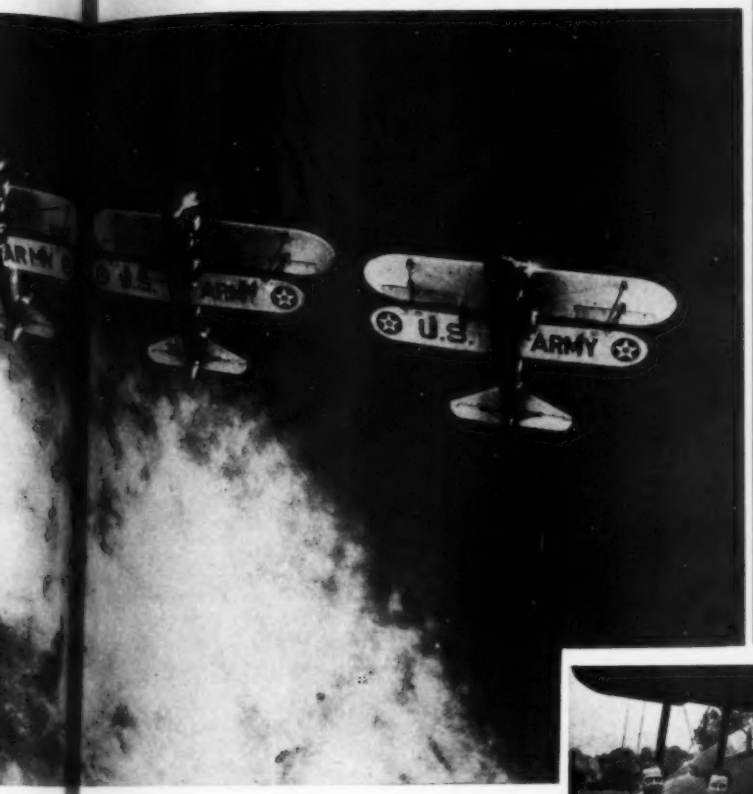
Sea and cloud : A pleasing impression of the Singapore III's of Nos. 209 and 210 (G.R.) Squadrons leaving for the Mediterranean to join the anti-piracy patrol.

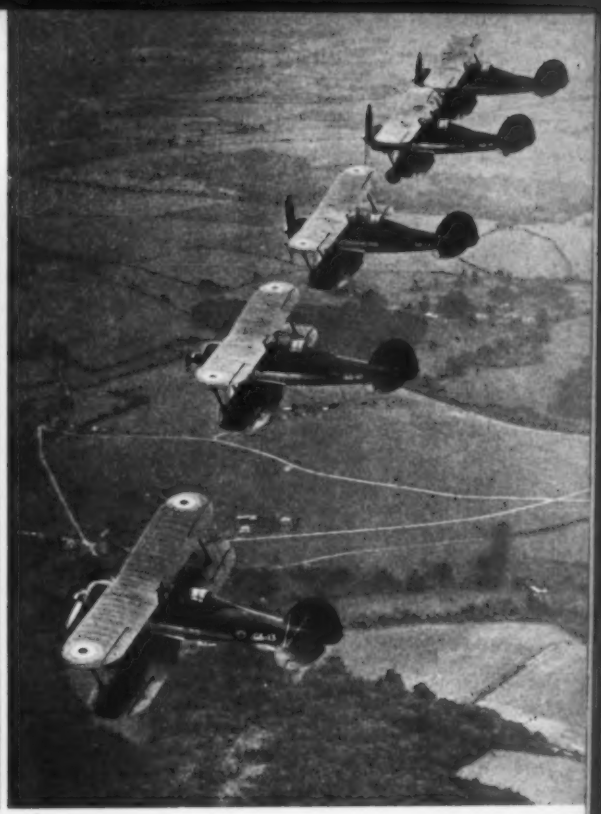
Against the Ohio sky : Three Boe[illegible]ters of Air Corps which gave an aerobati[illegible]ay at th[illegible] Races at C[illegible]d.

NEWS in PICTURES

(Below) A formation of Heinkel fighters during the military display which concluded the Nazi Congress at Nurnberg.

Staff Officers were flown over in a Bristol Bombay [tro]m last w[illegible] to Germany to attend the German army manœuvres. [L]to right : Brig. Gen. Pakenham Walsh, Wing Cdr. Maurice Moore, A[illegible]rshal Sir (Commandant of the Imperial Defence College), Field-M[illegible] Sir Cy[illegible] of the Imperial General Staff), Group C[illegible] P. D[illegible]





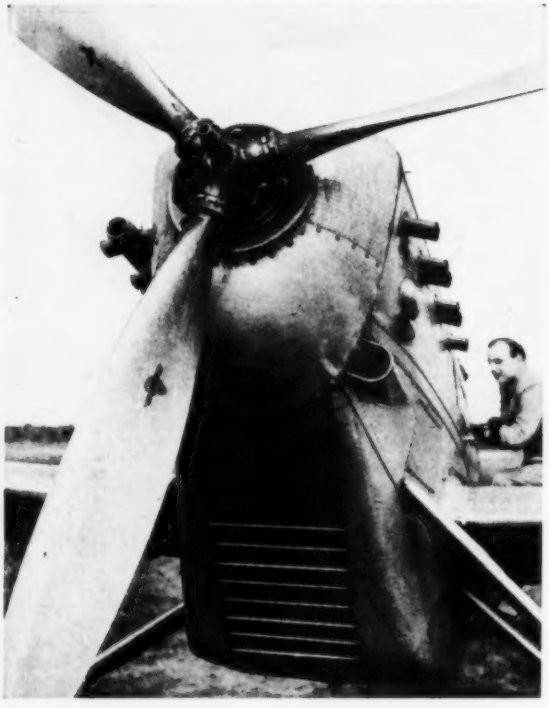
Three Boe[illegible]ters of the U.S. Army [illegible]n aerobatic [illegible]ay at the National Air [illegible]races at Cl[illegible]d.

Some Aspects of Service Aviation at Home and Abroad

(Right, top to bottom) Belgian Air Force officers called at Hucclecote last week to collect nine Gloster Gladiators, part of a contract. Their formation work—the photographs were taken only a few minutes after they had entered the machines for the first time—is testimony to men and machines. Group, left to right: Adj. Pessendorffer, Adj. Bochmann, Adj. Piercot, Mr. N. Daunt, Adj. Wegria, Flt. Lt. P. E. G. Sayer, Adj. Cluytens, Lieut. Elroy, 2nd. Lieut. Creteur, F/O. Maurice Summers, Capt. Le Grand, Mr. J. Hindmarsh, M. Vanderghote. (*Flight* photo.)

[illegible]nbay troop[illegible]er last week from Hendon [illegible]œuvres. [illegible]o right: Lt. Col. Neville, [illegible]e Moore, [illegible]rshal Sir Arthur Longmore [illegible]), Field-M[illegible] Sir Cyril Deverell (Chief [illegible], Group C[illegible]. P. Don.

Steam-cooling as applied to an early Kestrel in a Hart. Note that the condensers cover the leading edges of the upper and lower planes.



On the whole, Continental installations of liquid-cooled engines cannot compare with Rolls-Royce practice. This view shows the Hispano X "cannon" engine in the Dewoitine D.500 fighter bought by the Air Ministry.

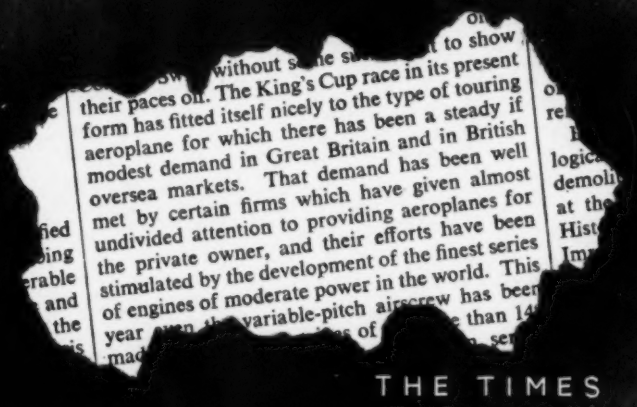
This method of cooling, unfortunately, demands a large radiator which may be responsible for an unconscionable amount of drag, so attempts have been made to reduce the area of the radiating surface.

Skin-type radiators have been tried with a view to lessening resistance, liquid coolants with high boiling points have been employed in place of water, and various systems of evaporative and semi-evaporative cooling have been evolved.

Except for racing machines, skin or surface radiators have been unsuccessful. The manufacture and application of the thin layers of metal skin between which the water passes are matters of considerable difficulty. The weight tends to be higher than for a honeycomb installation, and a large area is covered by the radiating surface. In these days of high wing loadings and limited areas this latter

Exhaust driven superchargers are incorporated on the glycol-cooled Curtiss Conqueror engines of the Consolidated two-seater pursuit monoplanes of the U.S. Army Air Corps.

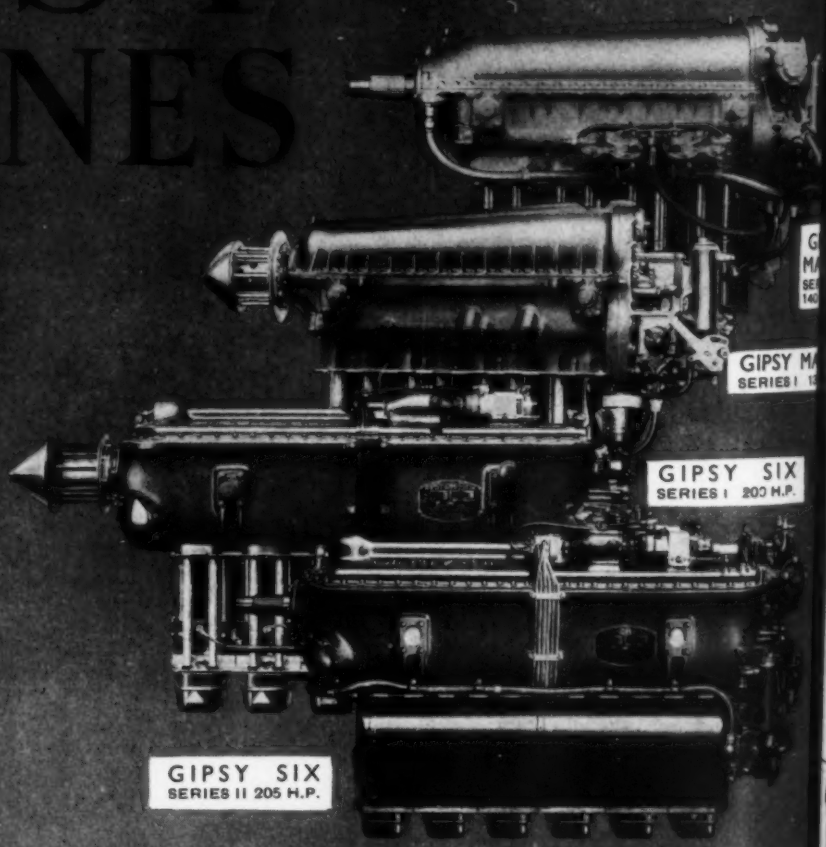
SHORT BROS (ROCHESTER & BEDFORD) LTD
England



their paces on. The King's Cup race in its present form has fitted itself nicely to the type of touring aeroplane for which there has been a steady if modest demand in Great Britain and in British oversea markets. That demand has been well met by certain firms which have given almost undivided attention to providing aeroplanes for the private owner, and their efforts have been stimulated by the development of the finest series of engines of moderate power in the world. This

THE TIMES

GIPSY ENGINES



THE DE HAVILLAND AIRCRAFT CO. LTD., HATFIELD AERODROME, HERTFORDSHIRE, ENGLA

The new Bell multi-seater fighter—America's latest—exemplifies the possibilities of the liquid-cooled engine for pusher installations. The power plants are actually the new vee-twelve Allisons with turbo-blowers.

consideration is a more decisive factor than a few years ago.

The use of high-temperature coolants in a more or less conventional system with reduced radiating area has given excellent results. Most common of the chemical coolant family is ethylene glycol or prestone, which boils at 197 degrees C. and permits a reduction of about two-thirds in the size of a radiator designed for English summer conditions as well as reducing the amount of coolant required. This chemical was originally used in aircraft as the basis for anti-freezing solutions, but later the opportunities for cutting down radiator size were exploited. The use of ethylene glycol entails very careful jointing and packing. This medium, operating at normal and maximum outlet temperatures of 95 and 120 deg. C. respectively, cools the Rolls-Royce Merlin described in *Flight* last week, and as this engine is frequently provided with a ducted radiator the total cooling drag is very low indeed considering the power of the engine.

Systems utilising the evaporative cooling of steam have not met with the success that was at one time anticipated, although semi-evaporative cooling is employed on certain standard R.A.F. machines, notably the Mk. II Fury and the Hind with Kestrel V engine.

Latent Heat

In the evaporative cooling system the water in the cylinder jackets is kept under a slight pressure. When the pressure is reduced to atmospheric the water turns into steam and is transferred to a condenser preparatory to being led back into the jackets. Because the latent, as opposed to the sensible, heat is utilised, a substantial reduction may be effected in the amount of cooling water required.

The so-called composite or semi-evaporative cooling common on Rolls-Royce engines to-day is a combination of water and steam (or evaporative) cooling. In level flight the engine is, to all intents and purposes, water-cooled, but the system may be operated on the climb right up to its boiling point under a slight degree of pressure. The steam thus formed, owing to the comparatively small size of the radiator, is transferred to an auxiliary condenser usually mounted in the leading edge of the centre section.

This system should not be confused with another "hybrid" scheme which has been introduced where there was insufficient area for a full set of leading edge condensers. In such cases a small retractable honeycomb condenser was provided for use on the climb, cooling in level flight being maintained solely by the leading edge condensers.

A troublesome problem with large-scale steam cooling was the difficulty of returning the hot condensed water without the formation of air locks.

One of the greatest advances in cooling technique for many years is the ducted, or tunnel, radiator as applied to certain of our new Merlin-powered fighters and bombers. At high speeds this invention may actually contribute to, instead of detracting from, the propulsive force. It will be realised that, as the cooling effect is roughly proportional to the square of the speed, it is necessary to obtain low-speed cooling if excessive drag is to be avoided. Accordingly, air can be arranged to enter a cowl which has a retarding effect before the air reaches the radiator proper. The stream of air passing comparatively slowly through the radiator gives efficient cooling, but it becomes necessary to speed it up so that it joins the main air stream at a speed not less than that of the aircraft, so the air passage is contracted. In other words, by slowing down the air without producing serious eddying, which would result in energy loss, pressure is built up at the point of entry to the radiator, and the air on leaving the radiator is under even higher pressure, due to the heat absorbed. The air is then speeded up again preparatory to being passed out into the main air stream through the contracted passage. The additional heat energy from the radiator causes the system to act as a kind of heat engine and may be considered as giving a jet-propulsion effect.

Zero Drag at 300 m.p.h.

The propulsive efficiency becomes greater as the speed of the aircraft rises. Drag may be reduced to zero at 300 m.p.h. The scheme may be further developed by the introduction of the energy of the exhaust gases in a suitable duct system, and it is said that zero drag would then be attained at 140 m.p.h.

Such developments may go far toward establishing the liquid-cooled engine on an even firmer basis, and should aid in the attainments of such ideals as buried engines for high-speed multi-engined aircraft. The problems involved in the installation of an engine deep in a mass of fuselage or wing are, of course, comparatively simple where the liquid-cooled unit is concerned, although there are reports of successful air-cooled installations employing carefully planned systems of scoops and ducts for the cooling air.

Rolls-Royce's Latest

Meanwhile, the latest cowling and cooling systems developed by Rolls-Royce for use in conventional aircraft seem to be giving remarkably good results. According to the most recent practice, the radiator is carried below the crankcase (although the ventral or mid-ventral positions may be adopted if a particular installation so demands), and the header tank is located over the reduction gear housing, permitting a minimum of pipe work. A pressure cowling is fitted to the radiator, the flow of air through the matrix being adjusted by a flap at the exit. The same pressure cowl encloses the oil radiator which is also used in conjunction with the exit flap. In some instances the air intake itself is built into the radiator matrix, which means that all the excrescences associated with cooling are grouped in a common cowling, giving very beneficial results.

The Rolls-Royce development section at Hucknall is continually evolving installation improvements and offering suggestions to manufacturers who wish to make the most of the excellent qualities of the modern liquid-cooled power plant.

THE ROYAL AIR FORCE

SERVICE NOTES AND NEWS — AIR MINISTRY ANNOUNCEMENTS

MOVES OF SQUADRONS

No. 29 (Fighter) Squadron will move from North Weald to Debden by November 25.

No. 46 (Fighter) Squadron will move from Kenley to Digby by November 16, on which date it will be transferred to No. 12 (Fighter) Group.

No. 73 (Fighter) Squadron will move from Debden to Digby by November 9, on which date it will be transferred to No. 12 (Fighter) Group.

FLIGHT CADETSHIPS FOR AIRCRAFT APPRENTICES

Ex-Aircraft Apprentices W Beringer (of Portaferry, Co. Down), R. E. Harris (of Devizes), and B. G. Mace (of Amersham) from No. 1 School of Technical Training (Apprentices), Halton, have been selected for cadetships at the Royal Air Force College, Cranwell, on the result of the examinations held on completion of their three years' training as aircraft apprentices.

The "Viscount Wakefield" scholarships, valued at £75 each, have been awarded to Flt. Cadet R. E. Harris from the above list and to Flt. Cadet R. V. Herbert, an open competition entrant. The home town of the latter is Lydford, Devon.

CENTRAL FLYING SCHOOL CATEGORIES

The undermentioned officers and airmen have been recategorised:

A.2 to A.1

Flt. Lts. T. P. Gleave, P. A. Hunter, and J. R. A. Peel, Flt. Sgts. Johnson, W. J., and Rawlinson, J.

B. to A.2

Flt. Lts. D. P. McKeown, A. J. Biggar, M. Hastings, D. R. Keiller, and W. P. J. Thomson, P/O. H. C. Marshall, Flt. Sgts. Munns, A. C. L., and Hubbard, J. L.

No. 10 FLYING TRAINING SCHOOL

The undermentioned officers have been awarded special assessments on completion of a course of flying training at No. 10 Flying Training School, Tern Hill:—

Special Distinction

P/O. G. P. Harger.

Distinguished Pass

A.P/O. C. H. Clark.

TRANSFER OF OFFICERS TO THE RESERVE

The undermentioned short service officers should note that they become due in February-March, 1938, for transfer to the reserve, or (where indicated) for relinquishment of commission, on completing their period of service on the active list:—

General Duties Branch

Flt. Lts. *William Wallace Evan Oliver and Hamish McCulloch White.

Medical Branch

Flt. Lt. John McGovern, M.B., B.Ch.

* To relinquish commission, not liable for reserve service.

FORMATION OF No. 1 BALLOON CENTRE

No. 1 Balloon Centre will form at Kidbrooke on October 4, on which date it will be placed in the Fighter Command in No. 30 (Balloon Barrage) Group.

CHAPLAINS BRANCH

The undermentioned chaplains have been selected for permanent commissions, subject to physical fitness:—Rev. Alan Stanley Giles, B.A., and Rev. Gerald William Norris Groves, A.L.C.D.

INSTRUCTORS FOR TURKEY

The Turkish Government has engaged two British Air Force Officers—Wing Cdr. A. S. G. Lee and Sqn. Ldr. S. McKeever—as instructors at the newly formed Turkish Air Force Staff College. The contracts are to last for three years with a possibility of prolongation.

FOREIGN OFFICERS ATTACHED

Engineer Capt. J. Söderberg, of the Swedish Royal Flying Corps, is attached to the Home Aircraft Depot, Henlow, and Lt. Chalvay Makarasara, of the Siamese Air Force, has been attached to No. 8 Flying Training School, Montrose.

THE ROYAL EXODUS HUNT, BAGHDAD

It is proposed to hold a reunion dinner for past and present members of the Royal Exodus Hunt and their wives in London on Friday, October 8. Past and present members desirous of attending are requested to communicate with Sqn. Ldr. J. C. Barraclough, Headquarters, Training Command, Royal Air Force, Buntingsdale Hall, Market Drayton, Shropshire.

R.A.F. FOOTBALL ASSOCIATION

Honorary Secretary and Treasurer.—Flt. Lt. R. A. Whyte has succeeded Sqn. Ldr. F. Porter as honorary secretary and treasurer of the R.A.F. Football Association. His address is: Air Ministry (Room 513), Adastral House, Kingsway, London, W.C.2.

FLYING ACCIDENTS

The Air Ministry regrets to announce the following accidents:—

A/C.1 John Beresford Murfin lost his life in an accident which occurred in Moray Firth, on September 20, to an aircraft of No. 800 (Fleet Fighter) Squadron. He was a passenger of the aircraft. The pilot, F/O. Duncan Whiteley Balden, was rescued.

L.A/C. Reginald Denys Maxwell Gibb lost his life in an aircraft accident which occurred at Sunbury, Middlesex, on September 21. He was the pilot and sole occupant of the aircraft.

P/O. Malcolm Patrick Alexander Craig-Mooney lost his life as the result of an accident which occurred at Evenley, Oxon, on September 23. He was the pilot of the aircraft and A/C.2 Peter McGeehan, a passenger, was uninjured.

ROYAL AIR FORCE GAZETTE

London Gazette, September 17, 1937

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—F. B. Chapman (Acting Flight Lieutenant) (August 16); J. B. Ussher (August 27); E. A. Howell (Acting Flight Lieutenant) (seniority November 28, 1936) (August 28); H. M. W. Thomas-Ferrand, G. A. M. Pryde (September 3).

P/O. P. J. H. Harrington is promoted to the rank of Flying Officer (September 6); Air Chief Marshal Sir John M. Steel, G.C.B., K.B.E., C.M.G., is placed on the retired list at his own request (September 12); Sqn. Ldr. J. G. S. Candy, D.F.C., is placed on the retired list at his own request (August 12); Flt. Lt. R. F. J. Strange (Supplementary List) is transferred to the Reserve, Class C (September 1); P/O. W. Foulsham, M.C., is transferred to the Reserve, Class C (September 14); P/O. C. D. Beaumont resigns his short service commission (August 28); A.P/O. J. G. W. Jones resigns his short service commission (September 1); Acting Pilot Officer on probation P. G. Abercromby relinquishes his short service commission on account of ill-health (September 8); the short service commission of Acting Pilot Officer on probation R. H. Wilding is terminated on cessation of duty (September 7).

Equipment Branch

The following Warrant Officers are granted permanent commissions as Flying Officers on probation with effect from and with seniority of September 4:—A. W. Bridger, L. A. McIntosh, A. H. Gee, M.M., H. J. Bartlett, M. J. Sullivan, E. J. Adams, L. G. Wheeler, T. C. Wharfe, J. E. Linford, W. H. Crowe, H. C. Manuel, G. W. Salt, W. P. Williams, A.F.M., L. S. Rutley, A. V. Ebert, G. F. Dell, D. L. Eden, A. H. Brown, D. D. M. Davies, H. Corfield, M.M., C. J. Hutton, F. E. Bastin, H. Gedd, C. Stonebridge, E. G. Edmonds, F. J. Gracey, I. E. Phillips, F. P. Gee, H. B. B. Burns, R. A. Harvey, J. K. Osborne, E. R. Hoare, A. E. White, R. D. Robinson, D.C.M., McD. B. Manson, D. Holbrook.

The following Flying Officers are promoted to the rank of Flight Lieutenant (September 1):—E. E. Copper, S. W. Thomas, G. J. Parsons, W. H. Dyson, R. J. Williams.

Medical Branch

Flt. Lt. G. H. Morley, F.R.C.S., L.R.C.P., is granted a permanent commission in that rank (September 3); Flt. Lt. H. F. Harvey, M.B., B.S., is transferred to the Reserve, Class D (September 3).

Dental Branch

R. Scoggins, L.D.S., is granted a non-permanent commission as a Flying Officer with effect from July 6, 1931, and with seniority of January 6, 1931 (substituted for notification in *Gazette* of July 21, 1931); F/O. R. Scoggins L.D.S., is promoted to the rank of Flight Lieutenant with effect from July 6, 1933, and with seniority of January 6, 1933. (Substituted for notification in *Gazette* of July 11, 1933.)

Commissioned Engineer Officers

The following Warrant Officers are granted permanent commissions as Flying Officers on probation with effect from August 30, and with seniority of August 23:—H. Barnes, F. Wall.

Commissioned Signals Officers

The following Warrant Officers are granted permanent commissions as Flying Officers on probation with effect from and with seniority of August 30:—J. Farmer, S. E. Catt.

ROYAL AIR FORCE RESERVE

Reserve of Air Force Officers

General Duties Branch

A. W. H. Nelson is granted a commission as Flight Lieutenant in Class C (August 2); K. K. Brown is granted a commission as Flying Officer in Class C, with effect from September 7, and with seniority of May 7, 1930; W. A. Shorten is granted a commission as Flying Officer in Class C, with effect from September 14, and with seniority of May 14, 1934; the commission of Acting Pilot Officer on probation P. J. Stanley is terminated on cessation of duty (July 9).

AUXILIARY AIR FORCE

General Duties Branch

No. 600 (CITY OF LONDON) (FIGHTER) SQUADRON.—J. G. C. Barnes is granted a commission as Pilot Officer (August 17).

No. 611 (WEST LANCASHIRE) (BOMBER) SQUADRON.—P/O. D. W. S. Howroyd relinquishes his commission on appointment to a short service commission in the Royal Air Force (September 5).

No. 614 (COUNTY OF GLAMORGAN) (ARMY CO-OPERATION) SQUADRON.—The following are granted commissions as Pilot Officers on the dates stated:—M. L. Edwards (August 16); N. S. Merritt (August 17); P. Farr (August 18).

Equipment Branch

Flt. Lt. L. F. Caunter, R.A.F.O., relinquishes his commission on cessation of duty (August 14).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Wing Commander.—F. L. B. Hebbert, to Oxford University Air Squadron; for duty as Chief Instructor, 6.9.37.

Squadron Leaders.—G. M. Knocker, to No. 144 (Bomber) Squadron, Hemswell; to command, 8.9.37. P. D. Cracroft, A.F.C., to Station Flight, Abingdon; to command, 8.9.37. D. W. R. Ryley, to Headquarters, R.A.F., Far East, Singapore; for Armament duties, 7.9.37. G. R. C. Spencer, to No. 47 (Bomber) Squadron, Khartoum; to command, 20.8.37.

Flight Lieutenants.—F. W. L. Wild, to No. 33 (Bomber) Squadron, Ismania, 14.8.37. A. A. Saw, to Headquarters, R.A.F., Far East, Singapore, 9.9.37.

Flying Officer.—T. S. Rivett-Carnac, to No. 820 (Torpedo Spotter Reconnaissance) Squadron, 11.9.37.

Pilot Officers.—A. E. Robinson, to No. 213 (Fighter) Squadron, Church Fenton, 4.9.37. R. P. M. Gibbs, to R.A.F. Station, Gosport, 8.9.37. G. B. B. Doudney, to No. 107 (Bomber) Squadron, Harwell, 24.8.37.

Acting Pilot Officers.—B. F. Burbridge, to No. 7 (Bomber) Squadron, Finningley, 4.9.37. A. G. Gillespie, to No. 37 (Bomber) Squadron, Feltwell, 4.9.37. W. H. Martyn, to No. 41 (Fighter) Squadron, Catterick, 4.9.37. P. C. S. Bagley, to No. 50 (Bomber) Squadron, Waddington, 4.9.37. M. R. Atkinson, to No. 52 (Bomber) Squadron, Upwood, 4.9.37. J. W. Graafstra, to No. 66 (Bomber) Squadron, Duxford, 4.9.37. R. A. Thomson, to No. 72 (Fighter) Squadron, Church, Fenton, 4.9.37. D. S. Hoare, to No. 74 (Fighter) Squadron, Hornchurch, 4.9.37. C. A. Baskett, to No. 76 (Bomber) Squadron, Finningley, 4.9.37. J. Tilsley, to No. 77 (Bomber) Squadron, Honington, 4.9.37. J. R. Brown, to No. 99 (Bomber) Squadron, Mildenhall, 4.9.37. R. C. Beaman, to No. 108 (Bomber) Squadron, Cranwell, 4.9.37. H. W. Beggs and E. J. T. Clarke, to No. 115 (Bomber) Squadron, Marham, 4.9.37. D. C. Ross, to No. 148 (Bomber) Squadron, Scampton, 4.9.37. T. A. Darling, to No. 149 (Bomber) Squadron, Mildenhall, 4.9.37. D. F. Rixson, to No. 211 (Bomber) Squadron, Grantham, 4.9.37. F. L. H. Eddison and P. C. Pickard, to No. 214 (Bomber) Squadron, Feltwell, 4.9.37. J. D. Tillott and J. A. C. White, to No. 217 (General Reconnaissance) Squadron, Tangmere, 4.9.37. W. D. Hodgkinson, to No. 220 (General Reconnaissance) Squadron, Bircham Newton, 4.9.37. R. J. O. O'Neill-Roe, to No. 226 (Bomber) Squadron, Harwell, 4.9.37. N. K. Loyd and A. H. Simmons, to R.A.F. Station, Gosport, 4.9.37. R. L. C. Branson, R. H. Sherlock, to School of Air Navigation, Manston, 4.9.37. D. I. Fairbairn and E. W. Tremlett, to School of Army Co-operation, Old Sarum, 4.9.37. R. W. Turner, to No. 9 (Bomber) Squadron, Scampton, 4.9.37, and F. W. Miller, W. R. J. MacWhirter, to No. 10 (Bomber) Squadron, Dishforth, 4.9.37. L. T. Wallis, to No. 18 (Bomber) Squadron, Upper Heyford, 4.9.37. L. G. Bowler and A. R. Buchanan-Wollaston, to No. 32 (Fighter) Squadron, Biggin Hill, 4.9.37. W. N. Perioli, to No. 37 (Bomber) Squadron, Feltwell, 4.9.37. H. R. A. de Belleroche, to No. 52 (Bomber) Squadron, Upwood, 4.9.37. R. Coe, to No. 56 (Fighter) Squadron, North Weald, 4.9.37. H. A. Olivier, to No. 64 (Fighter) Squadron, Martlesham Heath, 4.9.37. D. A. Thom, to No. 74 (Fighter) Squadron, Hornchurch, 4.9.37. R. H. Bullard-Davies, to No. 76 (Bomber) Squadron, Finningley, 4.9.37. F. J. L. Duns, to No. 79 (Fighter) Squadron, Biggin Hill, 4.9.37. F. R. Jamieson and J. R. Pennington-Legh, to No. 36 (Torpedo Bomber) Squadron, Seletar, Singapore, 7.9.37. B. E. R. Bowden and I. T. B. Rowland, to No. 100 (Torpedo Bomber) Squadron, Seletar, Singapore, 7.9.37. E. J. S. Jones, to No. 205 (General Reconnaissance) Squadron, Seletar, Singapore, 7.9.37. P. H. Alington, to No. 230 (General Reconnaissance) Squadron, Seletar, Singapore, 7.9.37.

The undermentioned are posted to the units shown, on appointment to permanent commissions from the R.A.F. College, with effect from 31.7.37:—A. R. Oakeshott, to No. 15 (Bomber) Squadron, Abingdon. M. S. Donne, to No. 17 (Fighter) Squadron, Whyteleafe. P. Meston, to No. 21 (Bomber) Squadron, Lympne. G. V. W. Kettlewell, to No. 29 (Fighter) Squadron, North Weald. T. J. Hanlon, to No. 34 (Bomber) Squadron, Lympne. I. A. Mead, to No. 35 (Bomber) Squadron, Worthy Down. P. A. N. Cox, to No. 43 (Fighter) Squadron, Tangmere. P. S. Butler, to No. 49 (Bomber) Squadron, Worthy Down. J. F. Pearce, to No. 73 (Fighter) Squadron, Debden. W. E. G. Measures, to No. 74 (Fighter) Squadron, Hornchurch. P. G. Wykeham-Barnes, to No. 80 (Fighter) Squadron, Debden. J. A. Pitcairn Hill, to No. 83 (Bomber) Squadron, Turnhouse. R. H. A. Lee, to No. 87 (Fighter) Squadron, Debden. J. E. Grindon, to No. 98 (Bomber) Squadron, Hucknall. D. D. A. Kelly, to No. 103 (Bomber) Squadron, Usworth. E. H. Lynch-Blosse, to No. 104 (Bomber) Squadron, Hucknall. D. R. D. Green, to No. 108 (Bomber) Squadron, Cranfield. J. C. Archer, to No. 142 (Bomber) Squadron, Andover. C. F. Atkinson, to No. 151 (Fighter) Squadron, North Weald. H. N. G. Wheeler, to No. 207 (Bomber) Squadron, Worthy Down. J. McC. M. Hughes, to No. 218 (Bomber) Squadron, Upper Heyford. P. R. ap Ellis, R. T. Frogley, K. F. Mackie, L. D. Mavor, P. M. Wigg, to School of Army Co-operation, Old Sarum. J. P. D. Gethin and J. T. Wilkins, to R.A.F. Station, Gosport, H. F. Cox, P. W. Dawson, W. E. M. Lowry, J. M. N. Pike, and E. Tennant, to School of Air Navigation, Manston. G. P. Gibson, to No. 83 (Bomber) Squadron, Turnhouse, 4.9.37. E. B. Morse, to No. 110 (Bomber) Squadron, Waddington, 4.9.37. T. P. A. Bradley, to No. 166 (Bomber) Squadron, Leconfield, 4.9.37. L. M. Craigie, Halkett, to No. 214 (Bomber) Squadron, Feltwell, 4.9.37. A. Bruce, T. M. Bulloch, J. J. K. Fleetwood, and C. F. L. Tulloch, to No. 220 (General Reconnaissance) Squadron, Bircham Newton, 4.9.37. A. L. Taylor, to No. 226 (Bomber) Squadron, Harwell, 4.9.37. S. P. Woollatt and L. M. Barlow, to R.A.F. Station, Gosport, 4.9.37. J. R. Grice and H. O. Thwaite, to School of Air Navigation, Manston, 4.9.37. D. E. W. Adamson, H. B. Bell-Syer, J. A. L. Fowler, and H. G. F. Gaubert, to School of Army Co-operation, Old Sarum, 4.9.37. D. W. Edmonds, to No. 7 (Bomber) Squadron, Finningley, 4.9.37. A. W. Jackson, to No. 9 (Bomber) Squadron, Scampton, 4.9.37. R. Langebear, to No. 18 (Bomber) Squadron, Upper Heyford, 4.9.37. J. B. Coward, to No. 19 (Fighter) Squadron, Duxford, 4.9.37. H. M. S. Lambert, to No. 25 (Fighter) Squadron, Hawkinge, 4.9.37. R. J. Wilson, to No. 37 (Bomber) Squadron, Feltwell, 4.9.37. A. W. G. Stuart, to No. 38 (Bomber) Squadron, Marham, 4.9.37. J. Harrington and E. D. J. R. L. Whatley, to No. 51 (Bomber) Squadron, Boscombe Down, 4.9.37. W. A. Pattison and G. T. Stanley, to No. 62 (Bomber) Squadron, Cranfield, 4.9.37. J. B. Garland, to No. 78 (Bomber) Squadron, Dishforth, 4.9.37. L. V. E. Atkinson and R. J. McConnell, to No. 82 (Bomber) Squadron, Cranfield, 4.9.37. G. P. Hewson, to No. 108 (Bomber) Squadron, Cranfield, 4.9.37. P. E. Dundee, to No. 110 (Bomber) Squadron, Waddington, 4.9.37. O. R. Donaldson, to No. 115 (Bomber) Squadron, Marham, 4.9.37. J. G. Hick, to No. 142 (Bomber) Squadron, Andover, 4.9.37. G. P. Miers, to No. 149 (Bomber) Squadron, Mildenhall, 4.9.37. C. P. Wright, to No. 220 (General Reconnaissance) Squadron, Bircham Newton, 4.9.37. J. W. Baird and D. J. Devitt, to No. 269 (General Reconnaissance) Squadron, Abbotsinch, 4.9.37. M. D. Day, T. L. Howell, R. G. Knott, and E. W. Tate, to School of Army Co-operation, Old Sarum, 4.9.37. J. R. Bendell, I. U. McR. Gallaway, G. H. B. Hutchinson and J. G. Thomas, to R.A.F. Station, Gosport, 4.9.37. L. W. Skey, to School of Air Navigation, Manston, 4.9.37.

Accountant Branch

Wing Commander.—G. N. Simon, to R.A.F. Station, Cranwell; for Accountant Duties, 6.9.37.

Flying Officer.—R. C. S. Allin, to R.A.F. Station, Kai Tak, Hong Kong, 7.9.37.

Medical Branch

Squadron Leader.—A. A. Townsend, to No. 5 Flying Training School, Sealand; for duty as Medical Officer, 6.9.37.

Flying Officer.—J. R. McWhirter, to No. 3 Armament Training Camp, Sutton Bridge, 9.9.37. F. V. Maclaine, to R.A.F. Station, Digby, 6.9.37.

Dental Branch

Flying Officer.—F. C. W. Rudd, to Special Duty List; on appointment to a non-permanent commission whilst holding House Appointment at the Liverpool Dental Hospital, 1.9.37.

SERVICE FIREMEN

N.C.O. Specialists Show Their Paces at Cranwell : Latest Equipment Demonstrated

(Top) The foam-flecked fire-fighter is Mr. E. J. Williams, an Air Ministry expert, who puts the chosen N.C.O.s through their tests. (Above) Sqn. Ldr. Sandbags is being rescued to burn another day. (*Flight* photographs.)

EVERY other month about a dozen selected N.C.O.s are drafted to Cranwell for initiation into the latest methods of combating aircraft fires. At the end of a two-months' course, which includes drill with all equipment and appliances, experience with "dummy" fires and lectures on first aid, they are tested by Air Ministry experts prior to returning to their units for fire-fighting duties.

The passing-out tests of the last draft were made the occasion of a demonstration of the latest fire-fighting technique as practised in the Service. The present system is planned to employ the new Crossley tender lately adopted as standard equipment. The prototype of this most effective vehicle with its red, semi-streamlined bodywork was the object of general admiration at the last R.A.F. Display. It is now used for instructional purposes at Cranwell. Carrying a crew of five, including the driver, it is equipped with four cylinders of carbon dioxide gas (discharged through two hoses) and 200 gallons of water for projecting twenty gallons of saponine, a soda extract which may be considered as soap foam. The rate of discharge is controlled by the accelerator. Two members of the crew are provided with the latest pattern of asbestos suit produced by Bell's Asbestos and Engineering Supplies. While on duty they wear the lower half continuously, donning the remainder as the tender dashes to the rescue. In a really first-class blaze a number of flame-proof men would work in relays.

These Bell suits can be worn in the midst of the fiercest petrol fire for periods up to 3½ minutes, although such spells would rarely have to be endured. No means of artificial respiration are provided, endurance being dependent upon the ability of the fireman to economise in the use of his air supply. The men selected for rescue work must be of A1 physique and not subject to claustrophobia.

The equipment of the tender is by Auto Fire Protection, Ltd., and the Walter Kidde Co., Ltd. The latter firm, it may be recalled, specialise in CO_2 apparatus for the inflation of Fleet Air Arm flotation gear. Carbon dioxide is used in fire fighting to displace the oxygen in the air and extinguish the fire. The saponine blankets the affected area and prevents re-ignition of petrol vapour by smouldering matter.

In spite of such setbacks as a burst saponine hose, a leakage of CO_2 and a semi-asphixiated fireman (who had, it seemed, left his visor open), the demonstration was convincing enough, and Sqn. Ldr. Sandbags was rescued from amid the major *débris* of a Hart-Tutor concoction with great alacrity and finesse.

Defiant N.C.O.s in the latest Bell asbestos fire-fighting creations. (*Flight* photograph.)

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VARIABLE SPAN and VARIABLE WING AREA

An Investigation of Their Effect on Top Speed and Cruising Speed

By A. E. PARKER, B.Sc.

High cruising speed is rapidly becoming the aim of all aircraft operators, and designers are providing it by increasing the wing loading. Just how far it pays to go in the matter of wing loading does not appear certain, some authorities having laid down 30 lb./sq. ft. as the highest to which it is worth while going, and others believing that loadings as high as 45-50 lb./sq. ft. will be worth while. In the following article the author examines the aerodynamics of variable span (as a means to reducing wing area) and variable area, and arrives at some interesting conclusions.—Ed.

Variable Span

THE subject of variable span appears to be one which has received little attention in this country and also in America, but a German aeroplane was described in *Flight* in 1932 which had a variable span. Since that time variable span appears to have been forgotten except by France, where some time ago an aeroplane having variable span was reported to be under construction.

The object of varying the span of an aeroplane is to reduce the wing area and thus the resistance at high speed and hence obtain a higher top speed and cruising speed. In practice, the span is reduced by making each wing in two sections, an inner and an outer, the outer section telescoping into the inner when the aeroplane is flying at a fairly high speed.

It is proposed in this article to investigate the effect of varying the span of an elliptical-winged aircraft and to find the improvement in cruising speed and top speed over the same aircraft when fitted with wings of non-variable span, it being assumed that the all-up weight is the same in both cases.

Elliptical wings only have been considered because the induced drag for this type of wing is easily found.

Case 1

Aeroplane of all-up weight 40,000 lb. conventional elliptical wing.

Assume a landing speed of 65 m.p.h. and an overall k_L max. of .95. (It is assumed that some form of flap is used.)

$$\text{Wing area required } S = \frac{40{,}000}{.95 \times .00511 \times (65)^2} = 1{,}950 \text{ sq. ft.}$$

Assume the following drag coefficients (parasite or profile):

Wings	.006
Engines and cowls	.00111
Empennage	.00071
	.00782
Add for interference	.00125
Total profile drag coeff. .. =	.00907

(*Note.*—These coefficients are all referred to a wing area of 1,950 sq. ft.)

For an elliptical wing the overall induced drag coefficient is given by:—

$$k_{D_i} = \frac{2}{\pi A} k_L^2$$

It is thus apparent that by using elliptical wings complicated calculations by the Lotz method are *avoided. At least for an ordinary wing the calculations using the Lotz method are not unduly complicated but somewhat laborious. A in the above expression is, of course, the aspect ratio $\frac{4s^2}{S}$ where s is the semi-span and S, the wing area.

Assume an aspect ratio of 8 for this wing. Hence

$$k_{D_i} = \frac{2}{\pi 8} k_L^2 = .0796\, k_L^2$$

* Or by the method given in A.P.970 due to Glauert.

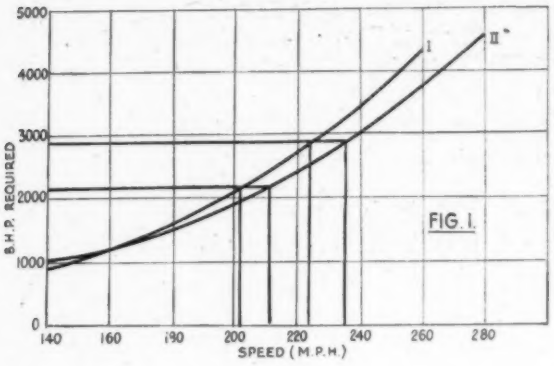

Fig. 1.

The total drag coefficient k_D is therefore :

$$k_D = .00907 + .0796\ k_L^2$$

and the drag D is :

$$D = (.00907 + .0796 k_L^2)\ .00511 \times 1{,}950\ V^2$$
$$= (.00907 + .0796\ k_L^2)\ 9.96\ V^2 \quad .. \quad .. \quad (1)$$

and the thrust horse-power (P_T) required at any speed V (m.p.h.) is given by :—

$$P_T = \frac{DV}{375} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (2)$$

Now k_L is given by the expression :

$$k_L = \frac{40{,}000}{.00511 \times 1{,}950\ V^2} = \frac{4{,}015}{V^2} \quad .. \quad .. \quad (3)$$

To find the top speed and cruising speed we therefore find k_L from (3) for a number of values of V (m.p.h.), calculate the drag from (1) and then finally obtain the thrust horse-power from (2).

This has been done in the table below and the results are given in graphical form in Fig. 1, curve 1.

I	II	III	IV	V	VI
V (m.p.h.)	k_L	$.0796\ k_L^2$	$.00907 + .0796\ k_L^2$	$V^2 \times 9.96 \times IV$	H.P. $= \frac{DXV}{375}$
140	.204	.003315	.01239	2,490	906.5
160	.157	.001965	.01104	2,830	1,208
180	.1241	.001228	.01030	3,330	1,600
200	.1005	.000804	.00987	3,940	2,100
220	.0831	.000618	.00969	4,680	2,750
240	.0698	.000387	.00946	5,420	3,465
260	.0595	.000281	.00935	6,300	4,370

Case II

Aeroplane of all-up weight 40,000 lb. same fuselage, engines and empennage as in Case I but with wings as shown in Fig. 2.

When the aeroplane is taking off and landing, the wing is as shown in the plan form Fig. 2, but when the aeroplane is travelling at cruising speed the part B is retracted into A so that C forms the tip of A and gives a perfect elliptical wing of aspect ratio 6. The part B will be called the outboard portion.

Wing area (outboard part retracted) $= \frac{\pi}{2} C_0 s$

Wing area (outboard part extended) $= \frac{\pi}{2} C_0 s + .566\ C_0 s$

$= 2.137\ C_0 s.$

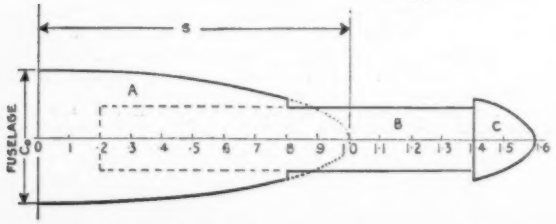

Fig. 2.—Plan form of wing of aeroplane considered in Case II.

where C_0 is the root chord and s is the actual span of one wing. Now it is assumed that the wing area of this plane with outboard parts extended is the same as before, i.e., 1,950 sq. ft., and that the k_L max. is the same, i.e., .95.

(The part A would be fitted with flaps and the part C would prevent partial loss of circulation over the part B.)

Therefore wing area with outboard part retracted

$$= \frac{\pi}{2} \frac{C_0 s}{2.137\ C_0 s} \times \frac{1{,}950}{1} = 1{,}433 \text{ sq. ft.}$$

The profile drag coefficients can now be estimated.

Profile Drag Coefficients (outboard part retracted).

Wings	.006
Engines.. ..	.0015
Empennage ..	.00096
	.00846
Add ⅕ for interference	.00169
..	0.01015 total profile drag coefficient.

It is easily found that in this case

$$k_L = \frac{5430}{V^2} \quad k_D = .0102 + .106 k_L^2 \text{ (for aspect ratio 6).}$$

$$D = k_D \times 1433 \times .00511\ V^2 \text{ and thrust horse-power}$$

$$P_T = \frac{DV}{375}$$ The values of drag and thrust horse-power have been worked out for various values of V and the results are given below and also in the graph Fig. 1, curve II.

I	II	III	IV	V	VI
V	k_L	$.106\ k_L^2$	$.106\ k_L^2 + .0102$	$V^2 \times 7.365 \times IV$	$P_T = \frac{DV}{375}$
140	.277	.00813	.01833	2,700	1,015
160	.212	.00476	.01496	2,820	1,205
180	.1676	.002975	.01318	3,180	1,530
200	.1355	.00195	.01215	3,580	1,910
220	.1122	.00133	.01153	4,110	2,410
240	.089	.000942	.01114	4,730	3,065
260	.0803	.000682	.01088	5,420	3,760
280	.0693	.000507	.0107	6,170	4,600

Strictly speaking, of course, the value of the profile drag coefficient of the wings should vary for each value of k_L, but for top speed and cruising speed this variation can be ignored and an average value assumed.

If the two aeroplanes are each fitted with four 880 h.p. engines and we assume that the net propulsive efficiency of the airscrews is .82, then the available thrust horse-power for top speed is : $4 \times 880 \times .82 = 2{,}886$ h.p., and drawing lines across on the graph we see that the top speed of Case I aeroplane is 223 m.p.h. and for Case II the top speed is 235 m.p.h., i.e., a gain in top speed of 12 m.p.h. Assuming that the cruising horse-power is three-quarters of the top speed horse-power the cruising speeds are :—

Case I Cruising speed = 201.5 m.p.h.

Case II Cruising speed = 211.0 m.p.h.

i.e., a gain in cruising speed of 9½ m.p.h.

Now assume a range of 3,000 miles in both cases.

Time of flight at 201.5 m.p.h. $= \frac{3{,}000}{201.5} = 14.9$ hrs.

Time of flight at 211 m.p.h. $= \frac{3{,}000}{211} = 14.2$ hrs.

Assume a petrol consumption of .5 pint per B.H.P. per hour.

Petrol load required by conventional aeroplane is $2640 \times .5 \times 1.02 \times 14.9 = 20{,}800$ lb.

Petrol load required by retractable wing aircraft is $2640 \times .5 \times 1.02 \times 14.2 = 19{,}130$ lb. Where 2,640 is the horse-power and 1.02 is the weight in lb. of a pint of petrol.

The saving in weight by using variable span is 20,800 lb. – 19,130 lb. = 1,670 lb.

The increase in cruising speed by using variable span is 9½ m.p.h., which does not seem to be a very big increase, but certainly worth having in the case of long-range air-

craft. Variable span is also worth while in the case of machines built entirely for speed, but for ordinary commercial aircraft the extra weight of the mechanism is hardly worth while.

The foregoing investigation is nothing like exhaustive, but it appears that for modern aircraft variable span is not a commercial proposition. Flaps appear to be far more effective, and, of course, the logical development is the use of assisted take-off, which will not necessitate an aeroplane carrying a lot of superfluous wing around with it so that it can take-off.

The reader will notice that the performance of the aeroplane has been compared for the two cases (1) when fitted with conventional wings fitted with flaps; and (2) when fitted with variable span and outboard portion retracted. It seems more logical to do this than to compare the aeroplane when flying at top speed with outboard portion extended, with aeroplane when flying at top speed with outboard portions retracted.

A point which requires investigation is the value of k_L max. for the full-scale wing in Case II with outboard part extended. The value of k_L assumed was .95 and this does not seem unreasonable when it is remembered that the aspect ratio for the wing in this case is 11.3 and that the portion A is assumed to be flapped. Of course, only a part of A could be flapped because part of A would be taken up with the ailerons. The subject of variable span is also closely linked up with structural strength, weight, and stability.

Appendix

The general equation for performance (top speed and cruising speed) of an aeroplane is :—

$$P_T = \left(\frac{2}{\pi A}\frac{W^2}{(.00511)^2 S^2 V^4} + k_{DW} + k_{DB}\right)\frac{.00511}{375} SV^3$$

Where P_T is the thrust horse-power available.

A, is the aspect ratio
W, is the all-up weight
S, is the wing area
V, the speed in m.p.h.
k_{D_W}, is the wing profile drag coefficient
k_{D_B}, the extra-to-aerofoil drag coefficient which varies with S.

Now, if the extra-to-aerofoil drag coefficient referred to an area S_1 is k_{D_B}, then when referred to an area S it is $k_{D_B}\frac{S_1}{S}$.

Substituting and rearranging we get :

$$V^4\left(k_{DW} \times \frac{.00511}{375} S + k_{DB} \times \frac{.00511}{375} S_1\right) - P_T V + \frac{2W^2}{\pi A(.00511)^2 S} = 0$$

This equation is, of course, only true for sea-level conditions, but it can be easily modified for various heights. Now, if the wing area S is varied, but the aspect ratio kept constant, then the only variables are V and S, except for a slight variation in k_{D_W} for various values of k_L.

The above equation can be used for finding V for various values of S, i.e., a given aeroplane is fitted with wings of varying area and the resultant value of the speed V can be found. By drawing a graph the maximum value of V corresponding to a certain value of S could be found. *The above equation is, of course, of the fourth degree which can be solved by the method of Ferrari or Descartes given in books on Higher Algebra.

If the aspect ratio is varied then for elliptical wings the area $S = \frac{\pi}{2} C_0 s$ and the aspect ratio is $A = \frac{8}{\pi}\frac{s}{C_0}$. These two expressions can be used to connect S and A when the aspect ratio is varied and thus avoid having too many variables in the above equation.

It would be interesting to see the results of other calculations on variable span, including the subject of weight.

(*Next month Mr. Parker will examine the effect of variable area.*—ED.)

* The equation is, of course, only of the second degree in S. In practice it is easier to solve the equation by drawing graphs as in the next part of this article.

DURALUMIN

IT is a somewhat curious fact that, in spite of the very large application during recent years of Duralumin to aircraft construction, the literature readily available to those unable to read languages other than English has been comparatively limited. *Flight* may, perhaps, be given credit for having published in THE AIRCRAFT ENGINEER supplement, one of the most useful earlier contributions, in the form of a series of articles by Dr. Leslie Aitchison. That was in 1926, and at the time the general knowledge of Duralumin was restricted. Consequently Dr. Aitchison's articles were welcomed by the aircraft industry. It seems rather extraordinary that not until now should a book dealing specifically with Duralumin have been published in this country.

In view of the rapidly extending use of Duralumin as the material for the primary structure of aircraft, in the form of sheet and extruded sections, the publication of such a book* is to be heartily welcomed. The author, Major Teed, is on the technical staff of Vickers (Aviation), Ltd., at Weybridge, a firm which has been closely connected, first directly, and later through James Booth and Co., Ltd., with the production of Duralumin in this country.

No better explanation, in a few words, of the scope and character of the book could be devised than the statement in the author's preface that the book "has been written by a metallurgist, not for metallurgists, but for those engineers whose task may be facilitated by the use of Duralumin."

* "Duralumin and its Heat Treatment," by P. L. Teed, 12s. 6d., Charles Griffin & Co., Ltd., 42, Drury Lane, London, W.C.2.

After a brief outline of the history and development of Duralumin, the author takes the reader through all the different stages of the treatment of the material which have resulted in such marked improvement in its physical properties, such as age hardening, heat treatment, annealing, normalising, and effects of stove-enamelling temperatures and of normalising.

The heat treatment of Duralumin has a marked effect on its properties, and this subject is dealt with very extensively. On the other hand, the author maintains a discreet silence concerning corrosion and the means for its prevention. So much so that neither "Corrosion" nor "Anodic Treatment" appears in the index nor, as far as the reviewer has been able to discover, do they occur in the text. In view of the now almost universal use of the anodic treatment, this seems surprising in a book which deals so ably and exhaustively with all the other treatments which Duralumin can be given.

A very minor mistake occurs in the footnote on p. 47. It was in 1926 and not in 1927 that *Flight* published in THE AIRCRAFT ENGINEER supplement Dr. Aitchison's series of articles on Duralumin.

In the history of Duralumin, brief as it is, mention might have been made of the derivation of a word which has come into general use all over the world. Few people, in Great Britain at any rate, will be aware that several years before the War the material was produced in Germany by the Dürener Metallwerke. From Dürener aluminium to Duralumin was but an easy step, orthoepically if not chemically, and Duralumin it became and remains in all the different languages.

MULTI-STAGE BOOST CONTROLS

By E. W. KNOTT, M.I.A.E., M.S.A.E.

AUTOMATIC devices for limiting the maximum induction pipe pressure in aircraft engines have been a recognised accessory on all English-built "blown" engines for some years, and other countries have come to appreciate the advantages they bestow, particularly with regard to the life of the engine. These early boost controls, while mechanically and functionally quite reliable, suffered from the inherent defect of lost motion of the pilot's throttle lever when the machine was below the engine's rated height, which made the exact speed control of the aircraft—under certain conditions—somewhat difficult. In addition, mixture strengths correctly proportioned to power output were not guaranteed, as it was possible for the pilot to leave his throttle lever in a position where rated boost could be obtained without the necessary power jet in action.

In *The Aircraft Engineer* supplements to *Flight* for April 25 and May 30, 1935, a full description of the Hobson Variable Datum Boost Control was given. It explained amongst other things how all lost motion of the pilot's throttle lever was eliminated, how the timing of the power jet was traversed as the machine climbed from sea-level to its rated height and why with this device it was impossible for the pilot to obtain rated boost without the power jet in operation. The variable datum boost control immediately made all earlier models obsolete and Fig. 1 shows the relative boost pressure curves of the ordinary and variable datum instruments.

Shortly after the advent of this new type of induction pressure limiter, automatic mixture control was introduced, following exacting tests over a considerable period. Its introduction was largely forced by the use of the constant speed propeller which prevented a pilot from

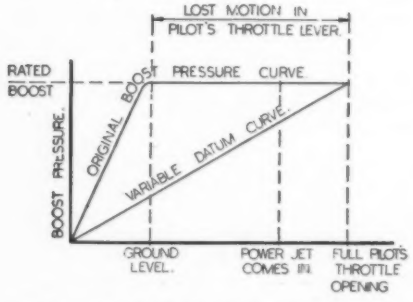

Fig. 1.—Comparative boost pressure curves.

checking his mixture strength by the time-honoured 3 per cent. rev. drop method, but its uncannily accurate and consistent control of fuel consumption on fleets of machines means that it has come to stay on the latter score alone.

Boost Override for Take-Off

Before the variable datum action was added to boost controls, provision was made for temporarily increasing the induction pipe pressure during take-off, this increase being accompanied by an enrichment of the mixture strength to prevent detonation, and this is still a desirable feature, especially in conjunction with a propeller the pitch of whose blades can be altered to give higher engine revolutions.

Modern flying technique, particularly for machines such as long-range bombers flying at high altitudes, demands that it shall be possible to fly on a cruising mixture strength with wide open carburettor throttle when conditions of power output warrant it.

Reference to Fig. 2 shows the power output curve of a 11,000 ft. engine flying up to and above its rated height. Rated boost at ground level gives 600 h.p. which increases to 660 at rated height, the increase being due to the reduction in exhaust back-pressure. During this climb the boost control has maintained ground-level pressure in the induction system. Beyond rated height the blower cannot sustain this pressure any longer and engine power

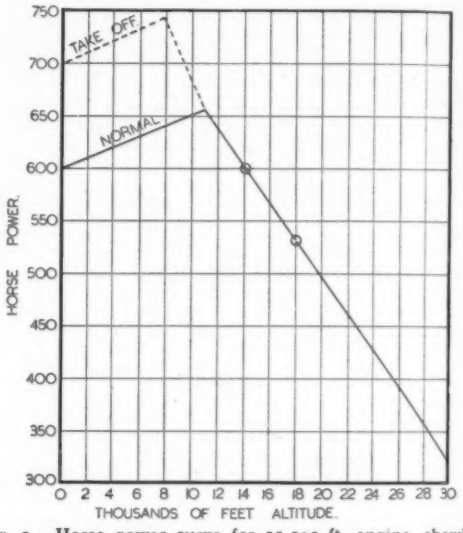

Fig. 2.—Horse power curve for 11,000 ft. engine, showing ability to fly at full throttle on cruising-mixture strength.

falls steadily until in this instance at 14,000 ft. the h.p. equals the ground level h.p. At a further 4,000 ft., the power output is equal to a safe ground-level cruising power in which the engine temperature does not call for the power jet to be in operation.

Three-Phase Boost Controls

This is a form of construction in which the "datum" of the boost control has three separate values, corresponding to maximum cruising boost, rated boost and take-off boost. These changes are obtained by means of three cams of different lifts operated by the pilot's throttle lever, means being provided for individual adjustment of each stage. As the power jet and enrichment jet are also operated by the pilot's throttle lever, these are timed so that from slow running up to maximum cruising boost only the main jet is in action. Between maximum cruising boost and rated boost the power jet comes into

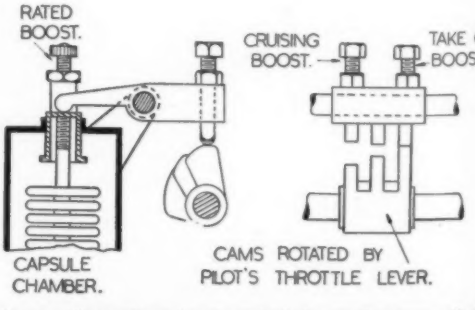

Fig. 3.—Three-phase boost control shown diagrammatically. The cam is shown in the take-off position.

operation, and between rated boost and take-off boost the enrichment jet valve is opened.

The contour of the cams is such that the essential variable datum action is kept, thereby retaining the smooth control of power output. The boost control linkage is so designed that with the pilot's lever in "maximum cruising" the carburettor throttle can be wide open, the boost control of course preventing this from happening until the necessary safe height above rated altitude is reached. Fig. 3 shows diagrammatically how a three-stage boost control operates. A hinged rocker-arm has a fork end which bears on an assembly carrying the pressure-sensitive capsule and the rated boost adjustment. The other end of the rocker arm is fitted with three pins, two of which are adjustable and

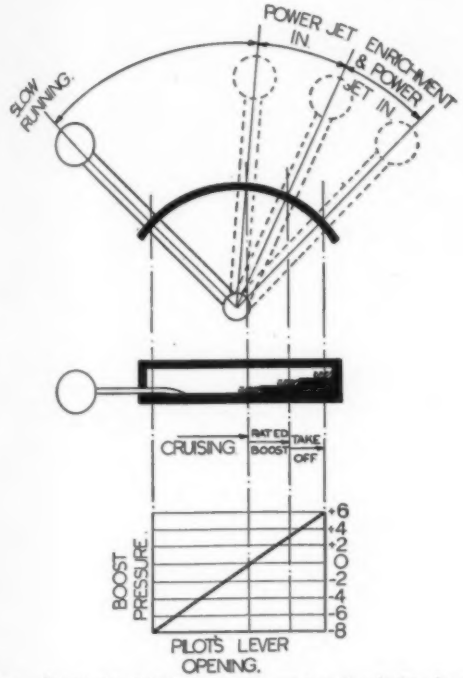

Fig. 4.—Pilot's throttle lever movement and relative boost pressure curve with three-phase boost control.

one fixed. These bear on the cams, the latter having short dwells during their angular movement, which dwells correspond with the three distinct boost pressures. A spring, not shown in the illustration, keeps the capsule assembly in contact with the fork end.

For instance, if the pilot's throttle lever is at the "Maximum Cruising" position and the boost control is set at, say, $-\frac{1}{2}$ lb., the latter will control at $-\frac{1}{2}$ lb. until an altitude is reached where the carburettor throttle is fully open. Similarly when the pilot's lever is in the "rated boost" position and the boost control is set at, say, $+\frac{1}{2}$ lb., the latter will control at $+\frac{1}{2}$ lb. to an altitude where the carburettor throttle is wide open, but of necessity lower than under cruising conditions.

Again, if the pilot's throttle lever is put into the "Take-Off" position and the boost control set to, say, +2 lb., this induction pipe pressure will be held to an altitude where the carburettor throttle is wide open, but a lower one than under rated boost conditions.

Throttle Lever Action

Fig 4 shows diagrammatically the movement of the pilot's special cockpit throttle control together with the relative mixture strengths obtained. Shown also is the kind of boost pressure curve obtained, the actual values being adjusted according to the figures fixed by the designer and with the assurance that up to rated

Fig. 5.—Twin-engine cockpit control for master control carburettor. Note the two throttle levers and single mixture lever.

height the lever can be put to any given position with the assurance that the same boost pressure is always obtained, as well as the required strength of mixture.

Master Control Carburettors

This is the name given by H. M. Hobson (Aircraft and Motor) Components Ltd., to a Claudel-Hobson carburettor into which is built a three-stage boost control and a two-stage automatic mixture control. A full description of this was given in the supplements to *Flight* mentioned earlier in this article and its method of operation is now well appreciated. Only two external levers are evident on these carburettors, a two-stage mixture lever having a "normal" or "weak" setting

Fig. 6.—Hobson master control carburettor, incorporating three-phase boost control, two-stage automatic mixture control, and all necessary linkage.

and a throttle lever operating the three-stage cam and boost control linkage.

The special cockpit control of which Fig. 5 is an actual example has the mixture and throttle levers so interlinked that the " weak " position can only be used when the throttle lever is between the minimum and maximum cruising positions. Any movement outside this range either to slow-running or to rated boost or take-off, first requires a mixture lever movement to " normal," thereby safeguarding the engine against incorrect mixture strength. Control of mixture strength at all altitudes from sea-level to the machine's ceiling is taken care of whether the pilot chooses the " weak " (maximum economy) or the " normal " (maximum power) setting and all necessary linkage, etc., for the boost and mixture controls are enclosed in a chamber in the carburettor which can be examined if required by removing an inspection cover.

Fig. 6 shows one of a variety of Master Control Carburettors, which are neat in appearance, have no external connecting rods as was the case when boost and mixture controls were hung on any convenient part of the rear end of the engine, and such a carburettor in conjunction with a special pilot's cockpit control relieves the pilot of all responsibility under any condition of flying, for boost pressures and mixture strengths. The latter is just as important as the former, owing to the large variations in specific fuel consumption on identical machines, the result of the human factor amongst pilots and hand-operated non-automatic mixture control; 40 to 50 per cent. differences being frequently recorded

TECHNICAL LITERATURE

SUMMARIES OF A.R.C REPORTS

REPORTS published by His Majesty's Stationery Office, London, which may be purchased directly from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, W.C.2; 120, George Street, Edinburgh; York Street, Manchester, 1; St. Andrew's Crescent, Cardiff; 15, Donegall Square West, Belfast; or through booksellers.

FULL SCALE AND MODEL RESISTANCES OF A SOUTHAMPTON II HULL. By E. T. Jones, M.Eng., L. Johnston, B.Sc., and J. Hanson, B.Sc., D.I.C. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1724. (26 pages and 21 diagrams.) August 27, 1935. Price 4s. net.

The full scale resistance of a boat seaplane has been deduced in steady and accelerated motion (Part I). The resistance of a one-seventh scale model in steady motion has been measured throughout a range of attitudes and loads at corresponding speeds (Part II). The resistances of the two scales of hull are compared (Part III).

The hull resistance measured in steady motion in the full scale tests is about 10 per cent. greater than the one-seventh scale model at 35 ft./sec., and about 25 per cent. greater at 70 ft./sec. These percentages may be in error by ± 5 per cent. and ± 10 per cent. respectively, because of the uncertainty in applying the full scale and model data on lift, drag and airscrew thrust to these particular experiments. It is possible that an appreciable proportion of this difference of resistance between the two scales is attributable to the effect of spray on the superstructure of the full scale seaplane and to the effect of rivet heads and lap joints on the hull.

PLANE TABLE METHOD OF MEASURING TAKE-OFF AND LANDING FLIGHT PATHS. By S. P. Osborne, B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1731. (14 pages and 10 diagrams.) November 11, 1935. Price 2s. 6d. net.

The method of measuring take-off and landing runs and barrier heights at a given distance from rest by means of marking positions on the aerodrome with flags, with subsequent chain measurement, has been superseded by a less tedious method. The measurement of barrier heights has been improved, horizontal distances are measured by means of bearings taken by three observers operating plane tables, while heights are measured with a double exposure camera, thus obtaining the climbing angle over the barrier.

The method enables satisfactory measurements to be made, while the time taken to carry out the actual measurements is considerably less than with the old method. The reduction of results, although apparently involved, is straightforward and reasonably quick. The method does not give the flight path during the approach for landing, but for C. of A. requirements this is not required.

FULL SCALE TESTS OF HARTSHORN AILERONS ON A BULLDOG. By A. E. Woodward Nutt, B.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1734. (17 pages and 6 diagrams.) February 26, 1936. Price 2s. 6d. net.

Wind tunnel tests of two types of Hartshorn ailerons are described in R. & M. 1587[1], and the results suggest that these ailerons should be an improvement on Frise ailerons, giving a more linear hinge moment curve and improved rolling moments, particularly at large aileron angles. The Hartshorn is essentially a modification of the Frise type, having a Frise section at the outer tip and the nose raised progressively from the outer to the inner end. The object of this is to cause the nose of the aileron to emerge progressively from above or below the wing contour as the aileron is displaced, instead of emerging over the whole of its span at once as with the Frise aileron.

Two types of Hartshorn ailerons were tested on a Bulldog aircraft, and various modifications made to the more promising type until a satisfactory control was evolved. Comparative handling tests were made with standard Bulldogs. Rough measurements were made of the forces used for normal operation of the standard and Hartshorn ailerons. The aircraft with Hartshorn ailerons, as finally modified, was flown by Service pilots from all Bulldog squadrons and by test pilots from the aircraft contractors.

The Hartshorn ailerons, as finally modified, are a better control and are less sensitive to errors in rigging than the standard Frise ailerons on a Bulldog. Control with the Hartshorn ailerons is light and smoothly progressive under all conditions of flight, except for a trace of overbalance for very large aileron movements. The ailerons are quite stable in dives at high speeds. Generally, the Hartshorn aileron seems a promising type of control in cases where relatively high balance is required.

[1] A. S. Hartshorn and F. B. Bradfield. Wind tunnel tests on (1) Frise aileron with raised nose, and (2) Hartshorn ailerons with twisted nose. R. & M. 1587. (1934.)

WIND TUNNEL TESTS ON SLOTTED FLAPS ON A LOW WING MONOPLANE: FLAP ANGLE 0° TO 90°. By D. L. Ellis, B.Sc., A.R.T.C., and M. B. Morgan, B.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1735. (12 pages and 11 diagrams.) January 9, 1936. Price 2s. net.

The Handley Page slotted flap when pulled down 20° or 30° is of the low drag type suitable for take-off. The following experiments give the characteristics of the slotted flaps on a low wing monoplane when used up to 90 deg., to explore the possibilities of this flap as a high drag flap for landing.

A 20 per cent. slotted flap gives the same maximum lift coefficient as a 15 per cent. split flap of the same span (though at a smaller flap angle), and when both flaps are down 60° they give the same drag. In taking off, the added drag due to slotted flaps is only about half that for split flaps giving the same lift coefficient. The low wing monoplane needs 1° more positive tail setting to trim when split flaps are used than when slotted flaps are used.

WIND TUNNEL TESTS TO DETERMINE THE EFFICIENCY OF AN AIRSCREW WORKING IN FRONT OF A THICK SECTION WING. By D. W. Bottle, B.Sc., and C. Callen. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1736. (12 pages and 6 diagrams.) March 3, 1936. Price 2s. net.

The present tests have been made in connection with a proposal to house a "Goshawk" engine completely within a thick section wing. An airscrew has been tested in three positions, approximately 10 per cent., 20 per cent., and 30 per cent. respectively, of the wing chord ahead of the leading edge, and in addition the effect of a thicker driving shaft fairing for the 30 per cent. position has been investigated. Measurements of lift, thrust minus drag, and torque have been made over a range of thrust and lift coefficients to include the operating condition at top speed.

The differences in nett efficiency of the airscrew when working in the positions tested at the same advance and wing lift were small, and within the limits of experimental error.

Ducted Radiators

NOTE ON PERFORMANCE DATA FOR HONEYCOMB RADIATORS IN A DUCT. By A. S. Hartshorn, B.Sc. R. & M. No. 1740. (21 pages and 8 diagrams.) December 12, 1935. Price 3s. net.

In this report the existing data on tube block radiators in a duct have been reviewed and formulæ have been found which give, with reasonable accuracy, the relation between cooling flow, rate of heat dissipation and pressure drop through the radiator.

The relation between rate of heat dissipation and cooling flow for any honeycomb radiator is given by a family of curves. It is also shown that this relationship can be described by a non-dimensional parameter termed the thermal ratio (η), i.e., the ratio of the rise in temperature of the cooling air to the mean temperature difference between coolant and air at entry. Over the range covered by the experimental data the pressure drop across a cold radiator is given with sufficient accuracy for design purposes as

$$3.2\,\eta \times \tfrac{1}{2}\rho v^2$$

where v is the mean air velocity through the tubes.

It follows from the above expression that the ratio of the work done in overcoming the pressure drop across the radiator to the heat dissipated (in work units) is $\frac{1.6\,v^2}{cp\,T_1}$.

This is 60 per cent. greater than the value which would be obtained from the Reynolds law connecting heat dissipation and friction if the temperature difference at entry is assumed to be applicable throughout the tube length.

ON THE EROSION OF SPARKING PLUG ELECTRODE MATERIALS AND THE VARIATION OF SPARKING PLUG VOLTAGE. By W. R. Debenham, B.Sc., A.M.I.E.E., and F. G. Haydon, A.M.I.A.E. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1744. (22 pages and 27 diagrams.) Price 3s. net.

This report deals with an investigation into the relative performance of a number of metals, including ferrous alloys, nickel chromium alloys, tungsten, stellite, and alloys with a nickel content exceeding 95 per cent., when subjected to a magneto spark discharge to determine the most suitable material for the electrodes of sparking plugs used in Service engines.

The results of the engine and laboratory tests cannot be correlated, particularly those of tungsten and the nickel alloys, and the performance of any metal for erosion and voltage should be determined by means of engine tests.

The erosion of tungsten is the least, pure nickel is second in order of merit, and all the nickel alloys, in general, show less erosion than the remaining materials. This conclusion applies for both standard and T.E.L. fuels, D.T.D. 224 and 230, respectively. Pure nickel has the lowest end-of-test voltage and all the nickel materials are superior to the remaining metals in this respect, due to a low impulse

ratio. Tungsten has a high end-of-test voltage due to its high impulse ratio, and is therefore, unsuitable.

Pure nickel is generally the most suitable metal at present available for the electrodes of sparking plugs used in Service engines, since both its erosion and voltage are low, and it is suitable for the construction of adjustable electrodes in the form of inserts in a steel centre and body. None of the materials showed any signs of chemical attack or disintegration at the end of the test, and the erosion was confined to a small area.

Previous tests have shown that thin deposits of the rare metals, platinum, rhodium or palladium on nickel electrodes are of no practical value.

AIRSCREW THEORY: A PAPER DELIVERED BEFORE THE FOURTH INTERNATIONAL CONGRESS FOR APPLIED MECHANICS, CAMBRIDGE, 1934. By C. N. H. Lock, M.A. R. & M. No. 1746. (11 pages and 11 diagrams.) November, 1936. Price 2s. 6d. net.

The object of this paper is to explain the theory of a method of calculating the performance of an airscrew of any given design on the basis of the Prandtl-Betz assumptions analogous to those of the better-known theory of a monoplane wing. This has previously only been possible in the general case on the basis of the assumption that the number of blades is infinite. It was known that calculations based on this assumption give reasonably good agreement with experiment for screws of low pitch, but no general method existed of assessing the theoretical errors of the assumption of infinity blades in any particular case.

The method described represents only a slight generalisation of the work of previous investigators such as Prandtl, Betz, Glauert, Trefftz and Goldstein, yet it is claimed that it goes some way towards supplying this deficiency. Although not rigorous in the mathematical sense, the method works by assuming the independence of reasonably small errors arising from different sources, in a manner analogous, for example, to the theory of planetary perturbations. The errors involved in the airscrew case are, of course, far larger than in the astronomical, but the final degree of accuracy required is correspondingly smaller.

For the sake of simplicity the method is explained by reference to diagrams showing the vortex sheets and the flow around them, rather than by the use of formulæ. Details of the formulæ may be found in a published paper.[1]

Ground Interference

FURTHER MEASUREMENTS OF GROUND INTERFERENCE ON THE LIFT OF A SOUTHAMPTON FLYING BOAT. By J. L. Hutchinson, B.A. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1747. (6 pages and 3 diagrams.) November 15, 1935. Price 1s. net

The magnitude of the effect of ground interference on wing lift, deduced from measurements of take-off and alighting speeds of a Southampton and reported in R. & M. 1621, is considerably in excess of that predicted by current theories. As the accuracy of the experimental results of that report is limited by the photographically recorded space-time curve, which gives the instantaneous values of the speed and acceleration at the moments of take-off and alighting, when these quantities are changing rapidly, it was decided to repeat the measurements in steady level flight.

These were checked by a photographic method at the height of the crane, 100 ft. from the water, so as to obviate any discrepancies due to different methods of measuring speed.

The measurements in level flight accord with the measurements made in take-off and alighting and show a substantial increase in lift due to the proximity of the ground. The change in lift increases as the incidence increases.

The magnitude of the interference is considerably greater than the theoretical value calculated by the equations of F/Res/73, and is approximately equal to the sum of the values for the upwash and curvature of flow effects without the deceleration effect.

THE STRESSING OF A PARTICULAR RIGID-JOINTED FUSELAGE UNDER BENDING LOADS. By J. Morris, B.A., and G. C. Abel, B.Sc., D.I.C. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1748. (21 pages and 2 diagrams.) April 9, 1936. Price 3s. net.

In R. & M. 1672 a rapid successive approximation method was given for stressing a plane frame with rigid joints. In order to illustrate the direct practical application of this method and also to obtain quantitative information as to the effects of rigid joints upon the stresses in the members of a frame, the method has been applied to the "rigid-jointed" fuselage of an actual aeroplane.

This fuselage has been analysed under a system of bending loads (i.e., no torsion present), and the maximum stresses occurring in each member found. The maximum stresses derived by conventional calculations assuming pin-joints have also been calculated.

The method is readily applicable to a fuselage under bending loads. For a particular example the maximum stresses derived were generally less than those indicated by conventional methods, but a number of considerations would require to be taken into account before allowance could be made in design for any such reduction.

THE STRENGTH OF LUGS. By Wm. D. Douglas, F.R.C.Sc.I., F.R.Ae.S., A.M.I.E.E. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1749. (21 pages and 16 diagrams.) October 9, 1935. Price 3s. net.

The estimation of the safe load which can be carried by a pin inserted through a hole in a sheet presents many difficulties which are intensified when the sheet has finite width and length and assumes the form usually known as a "lug."

It is usual to design such lugs on the basis of average tensile stress, or average shear stress, or average "bearing" stress. Since the distribution of tensile and shear stresses is of complicated type and is unknown under the conditions of chief practical importance where plastic deformation has commenced, the relation of the design stresses to fundamental mechanical properties of the material must be obtained by tests of particular lugs.

As the work involved in obtaining a complete solution is prohibitive owing to the number of variables in the geometry of the lugs, it was desirable to find the minimum number of tests which would suffice to determine safe design values for use with any particular material and with any reasonable shape of lug.

A series of lugs in material to B.S. Specification 2S.3 has been tested by loading through a hard steel pin. The lugs included extreme and normal proportions of width and length and included various shapes of end. Tests were also made on lugs cut from bar (materials 2S.6 and 4L.1) to investigate the effect of non-uniformity of the material.

Certain general relations between strength and geometrical proportions are obtained by suitable methods of grouping and plotting the experimental results. These relations allow conservative or "safe" estimates to be made of the load to cause either failure or distortion of lugs of a wide range of shapes. Numerical values are given for 2S.3 material.

A series of lugs suggested for use in obtaining similar information for other material is described.

The orientation of lugs in 2S.6 bar appears to have no serious effect on their strength, but in 4L.1 bar lugs may drop in strength by as much as 33 per cent. due to change of orientation or position in the bar.

REPORTS AND MEMORANDA OF THE AERONAUTICAL RESEARCH COMMITTEE PUBLISHED BETWEEN APRIL 1, 1935, AND NOVEMBER 30, 1936. R. & M. No. 1750. (8 pages.) November, 1936. Price 1s. 3d. net.

A STUDY OF THE FLEXURAL AXIS POSITION FOR CERTAIN BOX SECTIONS. By D. Williams, B.Sc., A.M.I.Mech.E., and D. W. G. Fairbank, B.Sc., D.I.C. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1751. (14 pages and 11 diagrams.) March 6, 1936. Price 2s. net.

Although the theoretical treatment given in R. & M. 1660 makes it possible to calculate the position of the flexural axis and the stress distribution for a thin-walled box section of any shape so long as the neutral axis is an axis of symmetry, it was considered that the analysis of certain simplified basic sections on the lines of that paper with the object of showing the influence of various parameters on the flexural axis position would be of interest to aeronautical engineers. The expression of the results obtained for such basic sections in terms of certain variable parameters makes it possible to apply them to cross sections of widely varying proportions. Further, as it has been the practice in some design offices to obtain an approximate position for the flexural axis by calculating the position of the centroid of the inertias of the stress-bearing parts of the structure, the position of this point, called for brevity "the centre of inertia," has also been calculated and compared with the position of the flexural axis.

The following types of box section have been considered :—Trapezoidal box and rectangular box with varying ratios of wall thicknesses; rectangular box with constant wall thickness but with an inserted partition of varying thickness and position and with flanges of varying proportions inserted in the corners. In the course of deriving the flexural axis positions it was necessary to calculate shear stress distributions appropriate to pure flexure, and the corresponding shear stress formulæ are therefore included in this report.

It is found that in many practical cases the position of the centre of inertia of a box section is a good approximation to the position of its flexural axis, and may often be used as a check upon, if not as a substitute for, the latter. It is found that any modification to the section that produces a shift of the centre of inertia usually produces a shift of the flexural axis in the same direction but of greater amount. The case where the modification consists of the introduction of flange reinforcements at the corners is an exception to these generalisations, but even in that case they still hold good if the flange reinforcements are short compared with the total width of the section, as they usually are in practice.

Gouge Flaps

FULL SCALE TRIALS ON SCION M.3 WITH A GOUGE FLAP. By J. Cohen, B.A., B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1753. (12 pages and 13 diagrams.) April 30, 1936. (Price 2s. 6d. net.)

The changes in the aerodynamic characteristics, take-off and landing qualities, caused by the flap, have been found for the Scion, a twin-engined, high-wing monoplane of 3,000 lb. maximum weight with a 46 per cent. span Gouge flap. Lift, drag, gliding angle and attitude curves were determined with flaps closed and open. Take-offs and landings with the flap closed, half and fully open were analysed from cinematograph pictures. The effect of the flap on stability and control was found qualitatively.

The flap decreases the minimum gliding angle from 7½° to 7°. To trim at constant speed, when the flap is opened, the elevator has to be moved down about 7° to correct tail heaviness, and the attitude is changed − 6°.

The flap half and fully open decreases the distance from rest to take-off by 14 per cent. and 23 per cent., and also decreases the distance from take-off to clear a 50-ft. obstacle by 21 per cent. and 23 per cent. respectively. The speed at take-off is reduced by 3 and 8 m.p.h. respectively. These same flap positions for landing increase the distance from a 50-ft. obstacle to touch by 10 per cent. and 7 per cent., decrease the distance from touch to rest by 27 per cent. and 34 per cent. and reduce the total distance by 13 per cent. and 18 per cent.; the touch speed is reduced by 6 and 9 m.p.h. respectively. The flap effect quickly falls off after the half-open position.

Lateral stability, which is poor near the stall, is improved when the flap is open, the ailerons becoming more positive. The elevator is affected adversely, and the rudder, which near the stall is weak, is unaffected by the flap; there is a trace of buffeting with flap open.

TURBULENT FLOW IN A CIRCULAR PIPE. By A. Fage, A.R.C.Sc. R. & M. No. 1754. (9 pages and 3 diagrams.) Price 1s. 6d. net.

This is a long abstract of a paper published in the *Philosophical Magazine*, Series 7, Vol. XXI, p. 80, January, 1936, and it contains the chief comparative data of various workers on the subject.

NOTES ON STUBS FOR SEAPLANES. By L. P. Coombes, B.Sc., and D. W. Bottle, B.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1755. (32 pages and 24 diagrams.) September 18, 1935. Price 5s. net.

Information was required as to the relative merits of a flying boat when fitted with stubs and with wing floats for lateral stabilisation on the water. In this country, very little experience of the behaviour of flying boats fitted with stubs is available, and only one such flying boat has flown successfully. Accordingly, a contract for alternative designs was placed with a firm of aircraft constructors and the necessary tank tests were made at the R.A.E.

Preliminary tests were made to determine the type of hull suitable for stubs, and then systematic tests to find the effect of changes of position and shape of the stubs were carried out. Wind tunnel tests were also made to complete the investigation. The results were supplemented by data from other tanks, and a comparison was drawn between the performance of the same seaplane when fitted with stubs and with wing floats.

(*a*) The shape of the hull to which stubs are attached is relatively unimportant, and a special design of hull is not required when this form of stabiliser is used.

(*b*) Some unfavourable wave interference between the stub and hull will occur at low speeds, but the position of the stub can be chosen so that the effect on the take-off is negligible. The effect of the different variables is given in the form of curves.

[1] C. N. H. Lock. "An Application of Prandtl Theory to an Airscrew." R. & M. 1523.

(c) The relative merits of stubs and wing floats will depend on the design, but provided that the stubs are set to give their optimum performance it appears that :—

(i) The weight of a stub design will be from 0.5 per cent. to 8 per cent. greater than the weight with wing floats.

(ii) The take-off time is approximately equal.

(iii) The lateral stability obtainable with stubs is less than that given by wing floats.

(iv) Longitudinal stability (porpoising) is unaffected by the change from stubs to floats.

(v) The maximum speed in flight is about equal.

(vi) From the experience gained in other countries, notably Germany, it would appear that the seaplane with stubs is the more seaworthy.

THE DISTRIBUTION OF STRESS IN MONOCOQUE WINGS. By H. F. Winny, Ph.D. Communicated by the Fairey Aviation Co., Ltd. R. & M. No. 1756. (12 pages and 3 diagrams.) September 5, 1936. Price 2s. net.

The tendency of modern aeroplane design to make use of a metal covering skin to carry loads has introduced several problems connected with the distribution stress in thin sheets. In particular, the distribution of stress in a thin metal wing covering, which has been suitably stiffened to take the direct stress due to the normal bending moment, is of importance. It is obvious that in this case the usual assumption made in the theory of bending of beams, *i.e.*, that plane sections remain plane after bending, must be applied with caution, especially where the skin is not continuous from tip to tip of the wing. Where the type of construction provides several webs extending along the span between the upper and the lower surfaces, the assumption might be expected to give a fair approximation, but where only two webs are provided the stress can only be transferred to the skin between the webs by shear stresses which may give rise to considerable distortion of the section.

The present investigation was undertaken to determine the distribution of direct stress in the skin extending between the front and rear spars for a given bending moment grading along the span, the method being suitable for dealing with a complete break in the fore and aft direction in the skin.

The basic equation developed is of the Laplace type, with an additional term for the camber of the skin. The method of solution consists of solving a set of simultaneous equations for the constants of a Fourier series which gives the stress. As an example of the method, the stress distribution is calculated in an actual wing carrying a given bending moment. Approximate formulæ are developed for use in special cases which may be of interest to the designer.

A GENERAL METHOD OF CALCULATING THE EFFECT OF AXIAL CONSTRAINT ON TORSION ON DIFFERENT FORMS OF TWO-SPAR, SKIN-COVERED WINGS. By A. E. Russell, B.Sc., A.F.R.Ae.S., of the Bristol Aeroplane Co., Ltd. R. & M. No. 1757. (16 pages and 11 diagrams.) November 18, 1936. Price 2s. 6d. net.

In R. & M. 1619, "Torsion of a Rectangular Tube with Axial Constraints," D. Williams, following the rigid methods of the theory of elasticity, illustrated the axial stresses induced by torsion of parallel tubes. The method outlined in this report, using the simple engineers' bending theory, gives substantially the same results and is capable of expansion to suit the varying characteristics of actual practice.

The solution to the problem involving rectangular cross sections is obtained by regarding the sides as four separate beams which resist bending and shear in the usual manner. The four spars interact one with the other since they are joined together at the corners. A set of conditions must be determined so that the external applied forces are balanced and also that there is no relative movement at the common edges.

The major assumption is that the rectangular cross section of the tube remains undistorted under load. The results of R. & M. 1619 show that the work done in deforming the shape retaining diaphragms is small so that the assumption is justified.

SOME APPLICATIONS OF CONFORMAL TRANSFORMATION TO AIRSCREW THEORY. By F. L. Westwater, B.A., Emmanuel College. Communicated by Dr. S. Goldstein. R. & M. No. 1759. (1 page.) July 30, 1935. Price 6d. net.

This is an Abstract and was published in the *Proc. of the Camb. Phil. Soc.*, Volume 32 (1936), pages 676–684.

Exhaust Silencing

PROGRESS OF EXPERIMENTS IN AERO-ENGINE EXHAUST SILENCING. By A. W. Morley, M.Sc. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1760. (18 pages and 19 diagrams.) June 6, 1936. Price 2s. 6d. net.

The purpose of this report is to summarise the present state of knowledge in the field of exhaust silencers and to record the series of experiments made at the Royal Aircraft Establishment over the last three years.

The performance of the three forms of silencer as obtained on a Kestrel engine running at 450 b.h.p. is as follows :—

	Weight, lb.	Noise reduction B.S. Phons.	Back pressure. lb. per sq. in.
Burgess	39	22	1.0
Vokes	35	26	1.6—3.2
Burgess-Farnborough, type J	39	26	1.5
" " " K	44	23	0.3

Two silencers are required for each (Kestrel) engine.

The Burgess-Farnborough type J and Vokes' type have successfully undergone flight tests of 50 hours' duration without any marked deterioration or trouble occurring. Burgess–Farnborough K type silencers have been in use on Heyford aircraft. The Burgess type loses some silencing with use owing to deterioration of the filling material.

Although from the scientific standpoint the theory of exhaust silencing is still incomplete, the technical problem has been advanced to the development stage

THE STRESSES IN CERTAIN TUBES OF RECTANGULAR CROSS SECTION UNDER TORQUE. By D. Williams, B.Sc., A.M.I.Mech.E. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1761. (34 pages and 13 diagrams.) May 2, 1936. Price 4s. 6d. net.

The behaviour under torque of a rectangular tube or box beam of constant section subjected to end constraints was investigated in R. & M. 1619[1] by the standard methods of the mathematical theory of elasticity. It is now found that by using the simpler bending theory of the engineer, results are obtained which approximate very closely to those obtained by the more exact theory. Moreover, it is possible to extend the approximate method so as to include such cases as tapered rectangular tubes and rectangular tubes in which opposite sides have different moments of inertia of cross-section, without introducing the complication which such an extension would involve if treated by more rigid methods.

Three types of torque loading are considered (*a*) torque applied at the free end, (*b*) torque uniformly distributed along the length of the tube; (*c*) torque concentrated at an intermediate point. The assumption is made throughout that the walls of the tube do not buckle.

In a tapered rectangular tube where the taper is considerable and of the type above described, the bending actions due to a tip-applied torque are appreciable throughout the length of the tube. They build up quickly at the free end and they remain fairly constant over the middle portion and finally sweep up to the root value. This is in contrast to the bending actions on a uniform rectangular tube under a tip-applied torque, which are negligible except near the root. It appears, however, that, so long as their root cross-sections and lengths are the same, the bending moment at the root of a uniform tube gives a good indication of that obtaining at the root of the corresponding tapered tube, but is always smaller. This applies not only to a tip-applied torque but also to a distributed torque and to a torque applied at an intermediate section. In the last case the bending moment at the point of application of the torque is, however, always a little smaller for the tapered tube than for the corresponding uniform tube.

When a torque is uniformly distributed along a well-tapered tube the bending moment curve does not fall away so rapidly with distance from the root, or fixed end, as it does in the case of the uniform tube, and although still negative over the outer portions of the tube may, in that region, become small enough to be neglected.

[1] Torsion of a Rectangular Tube with Axial Constraints. R. & M. 1619. May, 1934. D. Williams.

Improved Torsiograph

THE R.A.E MARK Va TORSIOGRAPH. By the Staff of the Engine Experimental Dept., R.A.E. Communicated by the Director of Scientific Research, Air Ministry. R. & M. No. 1762. (14 pages and 9 diagrams.) May 18, 1936. Price 2s. 6d. net.

The R.A.E. torsiograph apparatus has undergone improvements which are the subject of this report. There are two kinds of torsiograph instrument, one which measures the relative angular movement between two sections of a shaft, and the other which measures the angular variation of one section from steady rotation. The R.A.E. instrument is itself of the former kind, but it can be converted into the latter kind for particular purposes by securing its mirror mounting element to a floating flywheel suitably driven.

A description is given of the latest design of instrument (Mark Va) and of its corresponding floating flywheel mounting. Comments are made on experience gained with this apparatus. The apparatus functions satisfactorily, and the Mark Va is much easier to set up than the earlier instruments of the series.

A NOTE ON ROUGHNESS. By S. Goldstein, M.A., Ph.D. R. & M. No. 1763. (2 pages.) July 23, 1936. Price 6d. net.

For roughness to have negligible effect on turbulent flow, the criterion $\epsilon U_T/\nu < \sqrt{R_c}$ is suggested, where ϵ is the average height of the protuberances, R_c is the critical Reynolds number for the formation of an unsteady wake behind an obstacle of the shape of the roughnesses, $U_T = \sqrt{(\tau_0/\epsilon)}$, τ_0 is the intensity of surface friction, ϵ the density, and ν the kinematic viscosity. $\epsilon U_T/\nu < 5$ is probably sufficient.

ON THE APPLICATION TO TUBULAR FRAMEWORKS OF THE METHOD OF "SYSTEMATIC RELAXATION OF CONSTRAINTS." By MacDonell W. Woods, B.E., B.Sc. (Tasmania), and E. J. Warlow-Davies, B.Sc. (Tasmania), B.A. (Oxon). Communicated by Professor R. V. Southwell, F.R.S. R. & M. No. 1764. (22 pages and 3 diagrams.) July 1, 1936. Price 3s. net.

A problem, such as stressing a single bay of the hull structure of H.M. Airship R.100, after applying known forces to the joints of this framework, has been found to be intractable by relaxation methods in their existing state of development—mainly for the reason that little use can be made of the device of "block relaxation," and without its help joint relaxations, applied singly, yield a prohibitively slow approximation to the required result.

Some new device is needed which (like block relaxations) will permit large numbers of joints to be moved in one "operation" and one possible line of advance was suggested to the authors by Professor Southwell, based on the ideas of "quasi-harmonic analysis" which he has developed. Following this suggestion, the authors succeeded in obtaining a solution for the bay of R.100 which agrees satisfactorily with the experimental observations of Mr. Collins. The new extension of relaxation methods has thus permitted a considerable advance on the side of theory. Calculations for the complete bay of the airship structure (a sixteen-sided polygonal tube, tapered, and with joints around the bulkhead ring taken as stiff) are reserved for subsequent report, but a short comparison with experimental results has been included in an appendix to this paper.

ABSTRACT OF A FILM ILLUSTRATING THE THEORY OF FLIGHT. By H. C. H. Townend, D.Sc., F.R.Ae.S. R. & M. No. 1767. (8 pages and 27 diagrams.) Price 3s. net.

It was recently decided by the Air Ministry to produce a new educational film on the Theory of Flight for use at the training centres of the Royal Air Force. It was desired that the film should include sections dealing with fluid flow, and at the Air Ministry's request the required air-flow photographs were taken at the National Physical Laboratory.

The complete sound film contains sections dealing with actual aircraft, elementary theory, etc., but a shorter film has also been produced which contains only those portions which relate to air-flow. This has been made as a silent film and it has been amplified by some additions not considered suitable for the R.A.F. film, such as the flow through an airscrew.

The present paper is an abstract of those portions of the films which are of aerodynamic interest. Most of the films were taken at a speed of 20 pictures per second, but some were taken at speeds up to 2,300 per second to enable the details of transient phenomena such as turbulence to be exhibited in slow motion.

INDUCED DRAG DUE TO WASHOUT. By C. N. H. Lock, M.A., F.R.Ae.S., of the Aerodynamics Dept., N.P.L. R. & M. No. 1769. (5 pages and 1 diagram.) November 21, 1936. Price 1s. net.

The induced drag of a twisted wing may be calculated in a simple manner if the plan form is elliptic. The effect of a uniform washout is proportional to the square of the total angle of washout β, being given by the formula

$$C_D = 0.000033\ \beta^2 \text{ degrees}$$

for an aerofoil of aspect ratio 6. Thus for a washout of 2 deg. the increase of C_D is 0.00013 and for 5 deg. washout it is 0.00083 as compared with a value of $C_D = 0.00053$ (total induced drag) for zero washout at $C_L = 0.1$